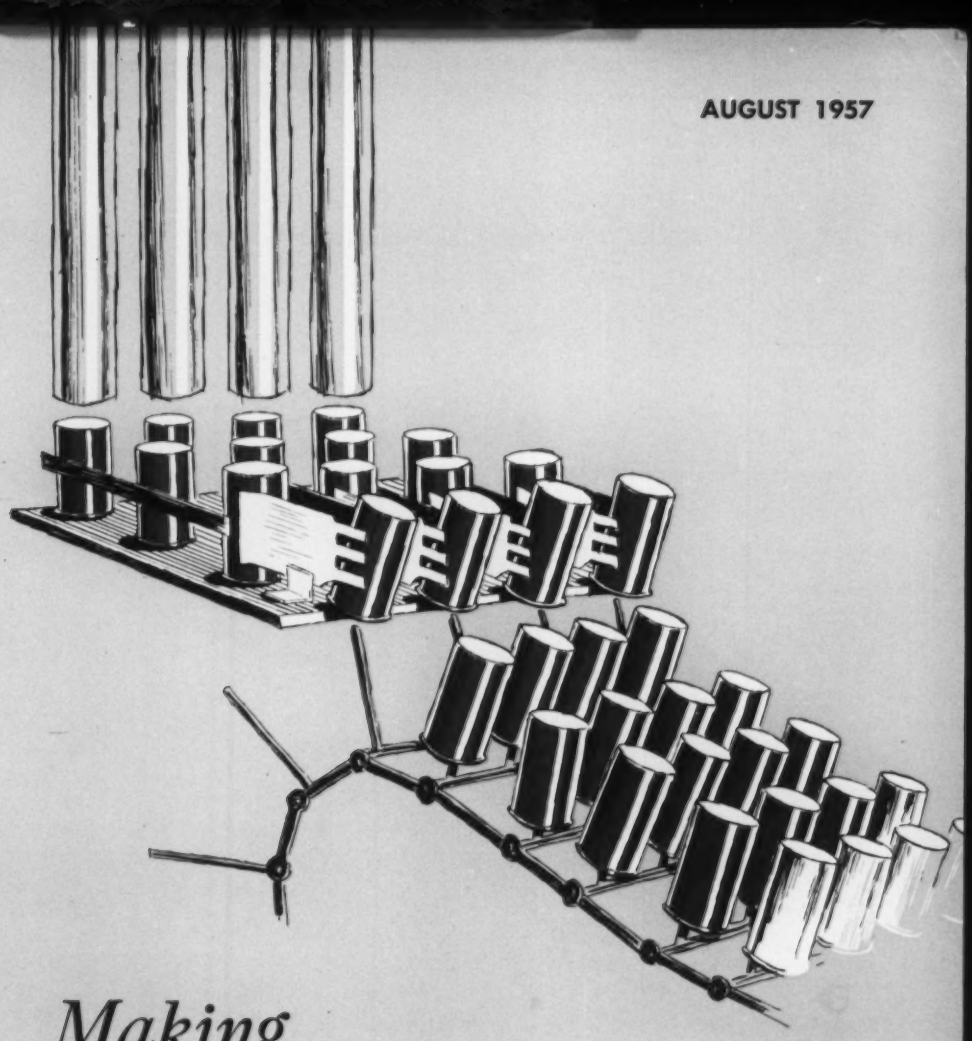
AUTOMATION

AUGUST 1957



Making Aluminum Cans

The Magazine of Automatic Operations

- **Automation Affects the Plant**
- **Hydraulic Control of Automatic Machinery**
- **Automated Motor Plant**
- **Centralized Control of Process Variables**

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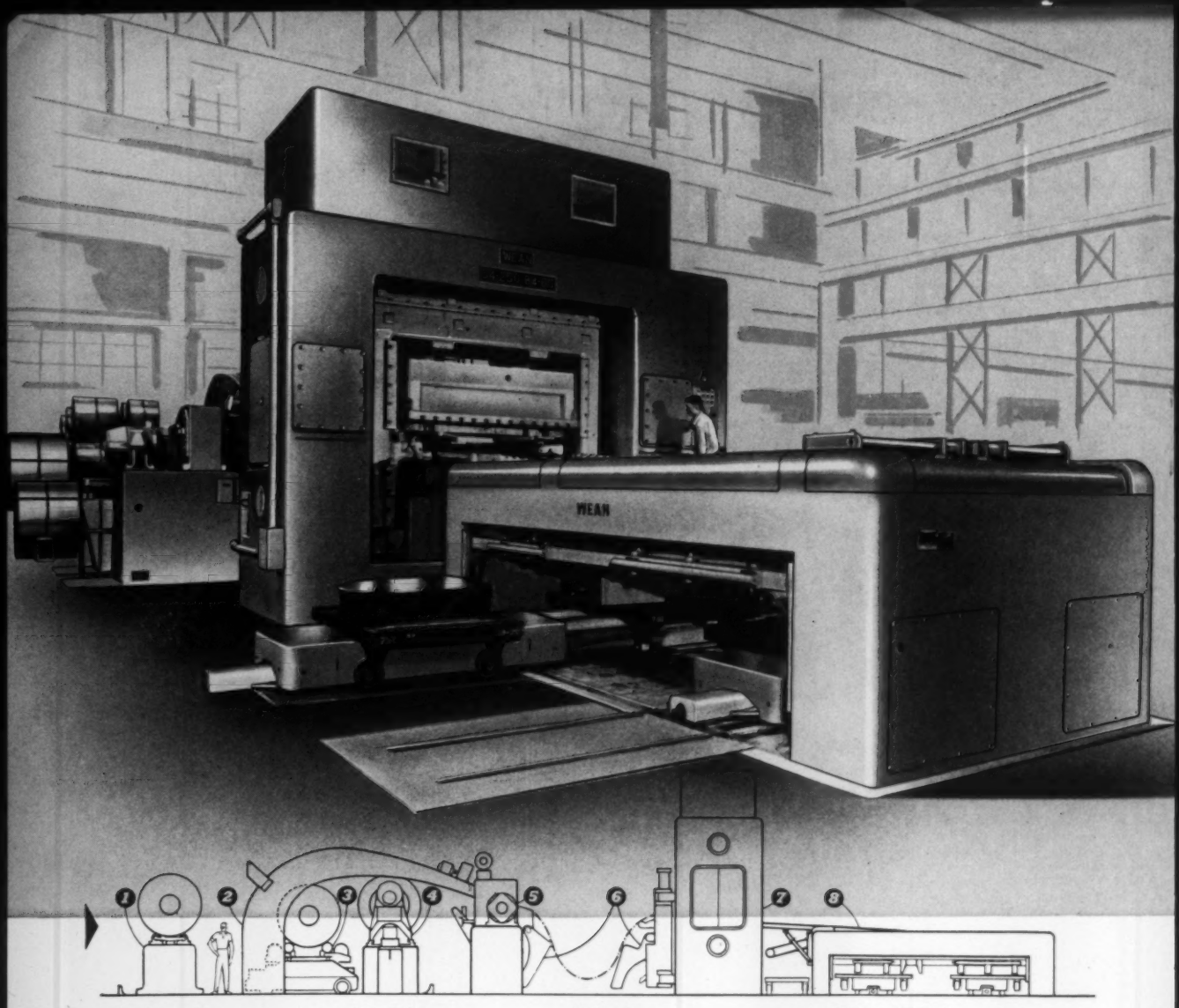
A PENTON PUBLICATION



1. Ready stand
2. Threading arms
3. Coil buggy
4. Cone-type Uncoiler
5. Leveler
6. Threading tables
7. "Flying-Press"
8. Automatic Piler

"Flying Press" Production Line

250 ton press line quadruples production of large heavy gauge parts

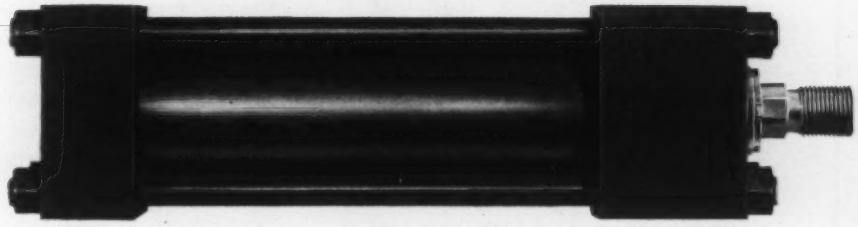
Dramatic proof of new production horizons is seen in the performance of this 250 ton "Flying-Press" production line engineered by Wean. Large heavy gauge automotive parts, formerly produced on modern presses, at rates up to 20 strokes per minute, are now produced on this Wean line at 90 strokes per minute.

The press is a 250-84-60 "Flying-Press." All components, from ready stand to stacking table, were engineered by Wean to work together as a single unit. Thus, the complete line is capable of producing at maximum press speeds. Consider, for a minute, how such production equipment can lower your per-unit manufacturing costs.

20 tons or 300 tons, whatever your press requirements, you will want the complete story on the "Flying-Press" and related units. Write today for your copy of the Wean "Flying-Press" Brochure.

Wean Equipment Corporation
CLEVELAND 17, OHIO

Circle 651 on Inquiry Card



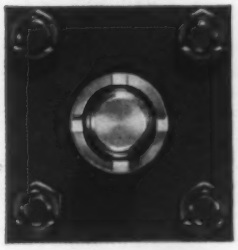
designed for leadership!

The superiority of Hannifin cylinders begins on the drawing board, where Hannifin designers have originated feature after feature not found in other air and hydraulic cylinders. But it doesn't end there...

Hannifin offers more kinds of cylinders, more sizes, more mounting styles. Each manufactured with such exacting control of dimensions and finishes that it not only looks like a better cylinder—its performance proves it!

As more and more discriminating specifiers and buyers are finding, the extra quality you get from Hannifin costs you no more, can usually be delivered sooner.

Why not specify Hannifin by name when you buy?



AIR AND HYDRAULIC

HANNIFIN

POWER CYLINDERS

Write for your copy of this new Hannifin Cylinder File—complete, easy-to-use, easy-to-order-from information on five lines of Hannifin cylinders. Hannifin Corporation, 541 South Wolf Road, Des Plaines, Illinois.

Circle 654 on Inquiry Card

CLARK Type "CY" Starters, sizes 0 and 1, now have higher NEMA horsepower ratings

As shown in the table below, NEMA maximum horsepower ratings for size 0 and 1 AC magnetic across-the-line starters have been increased. Clark Type "CY" starters now available to meet these new standards will, in many cases, permit you to meet your requirements with smaller sizes. You can at once take advantage of the money and space savings made possible by this re-rating.

CHANGES IN NEMA STANDARDS FOR MAXIMUM HORSEPOWER RATINGS OF AC MAGNETIC STARTERS AND CONTACTORS

SIZE AND VOLTAGE RATINGS	MAXIMUM HP RATINGS	
THREE PHASE	OLD	NEW
Size 0 110V	1½	1½
Size 0 208/220V	2	**3**
Size 0 440/600V	3	**5**
Size 1 110V	3	3
Size 1 208/220V	5	**7½**
Size 1 440/600V	7½	**10**
SINGLE PHASE		
Size 0 110V	1	1
Size 0 208/220V	1½	**2**
Size 0 440/600V	2	**3**
Size 1 110V	1½	**2**
Size 1 208/220V	3	3
Size 1 440/600V	5	5

NOTE: HP ratings for plugging and jogging duty have not been revised.

IN ADDITION TO COST AND SPACE SAVING BENEFITS OF THE NEW NEMA RATINGS, CLARK Type "CY" STARTERS OFFER MANY OTHER ADVANTAGES:

Greater Dependability and longer life

- Heavy-duty mill-type construction.
- Large silver-to-silver twin-break contacts.
- Vertical lift, free-floating magnet uses no springs; pull characteristic assures positive contact closing and keeps magnet slam to a minimum.

Easier Maintenance

- Contacts and contact springs quickly and easily inspected—without tools.
- All parts readily accessible and replaceable from front without removal from panel or enclosure—screwdriver and wrench only tools needed.
- Magnet coils easily replaced.

Simplified Installation

- Generous wiring space.
- All terminals face the front.
- Pressure-type terminals line and load.

...and many others

These increased horsepower ratings for AC controls will be adopted for all forms of Clark across-the-line starting equipment.

Revised Clark Catalog sheets and price lists covering the new NEMA ratings are available on request.

The **CLARK CONTROLLER** *Company*

Everything Under Control — 1146 East 152nd Street • • Cleveland 10, Ohio

IN CANADA: CANADIAN CONTROLLERS, LIMITED • MAIN OFFICES AND PLANT, TORONTO

Circle 655 on Inquiry Card

AUGUST 1957
Vol. 4—No. 8

AUTOMATION ®

A PENTON PUBLICATION

The Magazine of Automatic Operations

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automation outlook

FIRST STEP

". . . at present, increasing numbers of brick manufacturers are now taking the first step toward an automated production line by setting up simple packaging stations. The principle material used to hold their units together is steel strapping. A high degree of efficiency has been achieved through use of semiautomatic hand-operated and air power strapping tools together with certain basic strapping aids which assist the operator. While working toward the goal of complete automation, numerous firms in the brick industry are already achieving maximum packaging efficiency consistent with their present problems . . ."—*Arch N. Perry, Signode Steel Strapping Co.*

HIGHER PRODUCTIVITY NEEDED

". . . our gross national product is now advancing at double the rate of the work force. The only solution to the problem is automation, which will permit each man in the work force to increase his rate of productivity . . ."—*W. C. Allen, director of manufacturing planning, Westinghouse Electric Corp.*

POINT OF SALE RECORDING

". . . working with electronic speed and accuracy, our new system records sales at our point of origin, writes infallible sales receipts, and at the same time prepares data for the automatic creation of daily merchandise control reports, sales audits and accounts receivable records. By giving us more control information in less time, while freeing sales personnel from repetitive clerical work and the risk of error, it plays a vital part in helping us continue our successful branch store expansion program . . ."—*Bruce B. Dayton, executive vice president, Dayton's Dept. Store.*

FUTURE NEEDS

". . . indeed it is fortunate that our national productivity is increasing . . . because it will be necessary to increase total production some 50 per cent in the next ten years if we are to maintain our rising standard of living with a potential increase of only 15 per cent in working force. Anything, therefore, which increases productivity must receive our most careful attention . . ."—*Joseph Harrington, Jr., head, mechanical engineering section, Arthur D. Little, Inc., see page 40.*

LUBRICATION PROGRAM

". . . selecting and installing suitable lubrication systems on the various units or groups of units of an automated line is the beginning, not the end, of lubrication. These systems require maintenance, servicing and inspection just as the machines themselves do. A force of trained men who understand the importance of lubrication is needed for the work. In addition, the lubrication program should be carefully organized all the way from the origin of orders for lubricants through handling, storing, and dispensing to the point of application of lubricants. The cost of lost production due to unscheduled shutdown for repairs of an automated production machine is so great that the very best in lubrication—systems, lubricants, and men—can be justified . . ."—*R. F. Balow and J. R. Hicks, staff engineers, Socony Mobil Oil Co., see page 69.*

AUTOMATION

Penton Building, Cleveland 13, Ohio

Main 1-8260

R. C. JAENKE

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BPA NBP

ERIEZ

MAGNETS In Automation

NEW IDEAS from Eriez

For fourteen years Eriez has specialized exclusively in the design, manufacture and sale of high quality permanent magnetic equipment for machinery and conveyor manufacturers, design engineers, contractors and direct users. Our unique knowledge in the field of magnetic design and application has developed through experience gained by working in hundreds of a wide variety of industrial problems.

Eriez does not design, build or sell material-handling systems, but we serve people who do in areas where magnetic equipment should be incorporated. We willingly share the design- and field-application know-how gained through helping others move materials faster, more economically, more efficiently, more accurately by utilizing the inherent advantages of magnetism. And, since our engineers work closely with both system manufacturer and ultimate user, the most efficient installation is the end result.

Specifically, we produce standard lines of magnetic equipment and, in addition, design and build special components to *magnetically* convey, transfer, control, elevate, re-position, hold or re-orient basic ferrous materials or finished parts. Result? . . . materials move faster, more economically, more efficiently, more accurately—with complete control. Eriez automation units increase production, while lowering production costs. More positive hold reduces damaged parts, improves safety conditions.

Let **ERIEZ** *solve your magnetic automation problem! We'll be glad to help you in your special automation needs. For information or assistance, contact your nearest Eriez representative, or write direct giving as much advance information as possible. No obligation, of course. Eriez Manufacturing Company, 119-V Magnet Drive, Erie, Pennsylvania.*

Circle 656 on Inquiry Card

Eriez Magnetic Units provide these important AUTOMATION ADVANTAGES

First cost is the only cost

Powerful, self-contained magnets are virtually trouble-free

Magnetic strength is guaranteed indefinitely

No electrical accessories or wiring necessary

No power consumption; no operating costs

Maintenance is virtually eliminated

Less work space is needed

Positive hold permits faster conveyor speeds

Simple design, simple in function

Rugged design and construction; few moving parts

Choice of surface facings: hard or rubber coated for finished parts

Easily installed on new or existing equipment

Wide range of styles, sizes, magnetic strengths

No special skills or training needed to control, operate or maintain these units.

ERIEZ—pioneers and world's largest producer of permanent non-electric magnetic equipment for industry, has three major product lines to serve you:

HI-POWR MAGNETIC SEPARATORS—to remove unwanted iron from processing lines, ferrous from non-ferrous materials and iron contamination from liquids.

HI-POWR MAGNETIC AUTOMATION UNITS—to handle hundreds of materials-handling problems . . . to convey, control, transfer, elevate, re-position, etc., ferrous materials or parts during many manufacturing processes.

HI-VI VIBRATORY EQUIPMENT—to move and accurately feed bulk materials.

ERIEZ®

MICRO SWITCH Precision

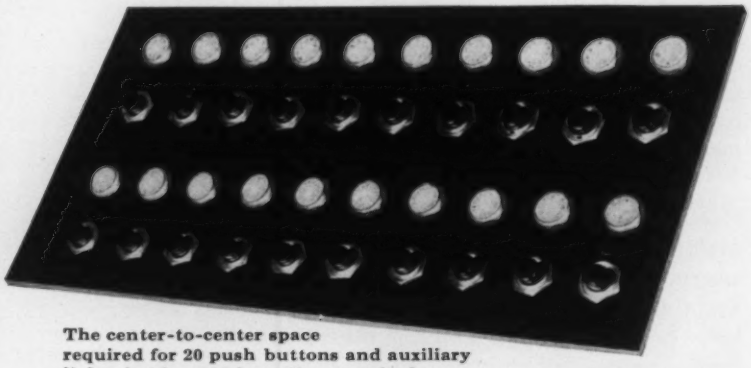
...FIRST IN PRECISION SWITCHING

Here is WHY you can

CUT PANEL SPACE **50%**

with MICRO SWITCH Illuminated Pushbutton Switches

Study this illustration... it shows how you can install a given number of MICRO SWITCH Pushbutton Switches—with illumination integral with the button in one-half the panel area necessary when push buttons requiring auxiliary on-and-off lights are used.



The center-to-center space required for 20 push buttons and auxiliary lights is 4 in. x 10 in.—40 square inches.

The center-to-center space required for 20 MICRO SWITCH Illuminated Pushbutton Switches is 2 in. x 10 in.—20 square inches.

FOUR SHAPES OF PUSHBUTTONS AVAILABLE IN FIVE DIFFERENT COLORS

These four translucent button styles are available for MICRO SWITCH Type 52 PB switches.

From the top they include (1) ¾ in. round; (2) ⅝ in. hexagonal; (3) ½ in. round; and (4) ¾ in. square.

They are available in red, yellow, green, blue and white.

(Send for Data Sheet #117)

The savings in space, in time; the difference in operating ease and surety—all commend the use of MICRO SWITCH Illuminated Pushbutton Switches instead of combinations of switch and separate auxiliary on-and-off signal lights.

Here are four NEW MICRO SWITCH Illuminated Pushbutton Switches with many unique and specific features, detailed for you on the opposite page.

In addition to their other features, these switches are obtainable with any one of four different shaped buttons, in five different colors.

Read the specific details of each as set forth on the opposite page. If this information is insufficient for your purpose, ask for Data Sheets by numbers as shown on opposite page.

Switches have uses unlimited

NEW!

MICRO SWITCH Turn-to-Lock-Down Lighted Pushbutton Switch

#52PB7-T2

This MICRO SWITCH lighted pushbutton switch is a dual-purpose switch. Pushed straight down, it functions as a conventional momentary pushbutton. A push and clockwise twist of the finger tip holds the switch in the operated position. A counter-clockwise twist returns the switch to the unoperated position. The low operating torque required permits the switch to be mounted flush or underflush on a panel without impairing ease of operation . . . This versatile switch can take the place of conventional push button, holding relays and separate indicator lights in many applications. Or it can take the place of an alternate-action pushbutton and provide optional momentary action.

CHARACTERISTICS: Operating force 34 oz. max. Pretravel .220 in. min. Overtravel .120 in. max. Two subminiature switches are SPDT.

(Send for Data Sheet #116)

NEW!

MICRO SWITCH "Space Saver" Lighted Pushbutton Switch —only 2 in. max. below Panel

#52PB51-T2

This MICRO SWITCH lighted pushbutton switch is invaluable in applications where space is at a premium. The switch has no pretravel spring mechanism which permits length to be reduced to 2.35 in. (less button). Only 2 in. max. required below mounting panel . . . This switch has a very definite snap-action "feel" and comparative high-force characteristics. Switch body contains a removable subminiature socket for the indicator lamp. Lamps are available for 6, 12 and 28 volts.

CHARACTERISTICS: Operating force—32 oz. max. Pretravel—.070 in. max. Total travel—.110 in. max. Two subminiature switches are SPDT.

(Send for Data Sheet #123)

ELECTRICAL DATA

The subminiature basic switching units used in these four assemblies have SPDT contact arrangement. Contact break distance is .010 in. min. Underwriters' Laboratories list the switches at 5 amps. 125 vac. 30 vdc ratings are: inductive 3 amps.—sea level, 2.5 amps. —50,000 ft. Maximum inrush rating: 15 amps. 125 or 250 vac and 30 vdc.

NEW!

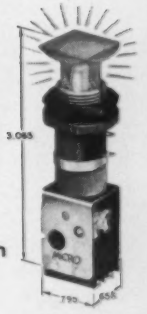
MICRO SWITCH Magnetic Hold-in Lighted Pushbutton Provides Three Functions

#53PB8-T2

MICRO SWITCH lighted pushbutton switch combines the functions of a three-pole double-throw pushbutton switch, indicating light, and holding relay into one compact unit which panel mounts on one-inch centers, both horizontally and vertically. Thus, the cost, wiring, maintenance and added space of these separate components are eliminated . . . A 28-volt dc solenoid is incorporated into the switch shaft. After the button is manually operated, the solenoid holds the switches in the operated position until electrically released. This feature gives the designer complete freedom in panel layout by eliminating the restrictions found in conventional mechanical release designs.

CHARACTERISTICS: Operating force—35 oz. max. Pretravel—.050 in. approx. Total travel—.090 in. max. Three subminiature switches are SPDT.

(Send for Data Sheet #128)



NEW!

MICRO SWITCH Alternate Action Lighted Pushbutton Switch— for Multiple Circuit Control

#52PB61-T2

This MICRO SWITCH lighted pushbutton switch provides on-off control of up to four circuits. With each push of the button, both basic switches are alternated between actuated and unactuated maintained positions, thus providing double-pole double-throw action. Every two pushes of the button completes a cycle of operation. Variations in the long-life nylon index cam are possible which will permit a number of other sequences.

CHARACTERISTICS: Operating force—40 oz. max. Total travel—.100 in. max. Two subminiature switches are SPDT.

(Send for Data Sheet #124)

MICRO SWITCH

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

In Canada, Leaside, Toronto 17, Ontario • FREEPORT, ILLINOIS

Sizes are to relative scale.

AUTOMATIC... stroke lengths infinitely adjustable to 6" . . . drills up to ¼" holes.

PAR-A-MATIC . . . 7 speeds . . . stroke and thrust adjustable . . . ¼" heavy duty capacity.

BANT-A-MATIC . . . 4 speeds . . . for portable or fixed mounting . . . ⅜" heavy duty capacity.

MIDG-A-MATIC . . . only 1" in diameter, 10⅝" overall . . . ⅛" holes and under.

HOLES COST LESS

with ARO DRILLS

AUTOMATIC DRILLING at LOWEST COST . . . because it's ALL AIR operated!

SINGLE OR MULTIPLE SET-UPS . . . widest range of applications.

FEWER MAN HOURS . . . greater output . . . higher quality.

CHOICE OF 4 precision-made drills . . . Aro dependability.

WRITE for complete literature. See your Aro distributor for help in planning multiple installations.

THE ARO EQUIPMENT CORPORATION
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ARO® **AIR TOOLS**
Also . . . AIR HOISTS . . . LUBRICATING EQUIPMENT . . . AIRCRAFT PRODUCTS . . . GREASE FITTINGS

Circle 658 on Inquiry Card

AUTOMATION news

Today's events and developments in the field of automation

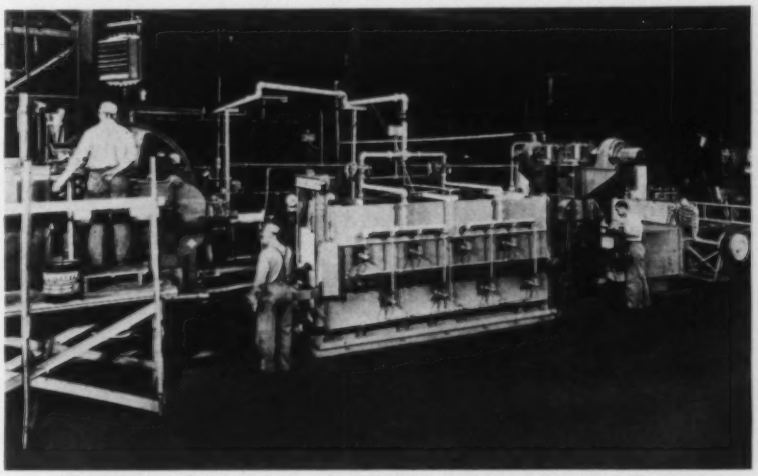
Equipment Manufacturer Offers Unique Engineering Service

ON THE OCCASION of the 100th anniversary celebration by the E. W. Bliss Co., **Robert Potter,** president, announced a new company policy which might be a bellwether for the heavy equipment industry. To satisfy the demand of equipment users for such a service, Bliss has announced that they are ready, willing and able to provide a "turnkey" plant service, not only for rolling mills, can making machinery, and metal working presses but also for a new powder metal process.

The "turnkey" plant service means that the company acts as contracting engineer for an entire job—from plant foundation to training the customer's personnel in the operation of the finished plant. All the customer need do is "turn the key" and begin operations. In such a system, Bliss builds some of the equipment, and contracts and buys other items.

The concept leading to the decision to act as contracting engineer is based upon the unique skill, experience and knowledge of a major equipment manufacturer which makes them more qualified than anyone else to design and build a plant which uses their equipment most efficiently.

As was mentioned, the services are available for customers interested in a powder metal sintering process for which Bliss developed machinery. With this process, metal strip, tubing and other products can be fabricated directly from powder, without first melting the powder and casting cakes or ingots. Equipment and operating costs are about 20 per cent of conventional rolling costs. The process can be applied to copper, nickel, titanium and other metals. A pilot model line has been established in their Salem, Ohio plant.



POWDERED metal sintering line developed by E. W. Bliss Co. fabricates parts directly from powder without requiring that the powder be melted. In the illustration, a metal powder feeds from hopper at left through compacting rolls, and is passed through a sintering furnace and hot mill rolls. The finished strip compares favorably with fine strip rolled by conventional multicycle rolling techniques.

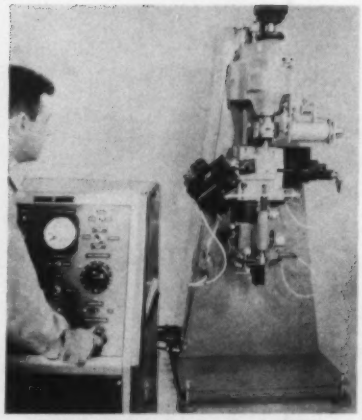
CELEBRATION of the 100th anniversary of the E. W. Bliss Co. affords the opportunity to review the strides which have been made in automatic machinery designed in the last century. This comparison is taken from the can machinery industry in which Bliss is a pioneer. The illustrated modern can bodymaker produces from 400 to 450 can bodies a minute.

Machine Translates Languages

COMPUTER has been programed by **Peter Toma,** technician at the California Institute of Technology, to interpret four foreign languages and automatically type out idiomatic English translations. The computer, a Datatron manufactured by ElectroData Division of Burroughs Corp., has been provid-

ed with four specially-condensed dictionaries of Russian, French, German and Spanish. Each dictionary comprises about 500 words and they are easily retained on the internal memory drum of the computer. When the machine is fed one of the foreign languages it does not merely produce a word-for-word record, but correctly renders the thought or sense behind each foreign phrase in accordance with a formula developed by Toma.

The range of the computer-translator can be enlarged considerably by the use of an expanded dictionary stored on ElectroData's multiple magnetic tape unit external memory. Ten of these external memories can be linked to the computer and can provide short access time to over 200 million characters of information.



INSTALLATION of a remote positioner enables the General Electric Co. to achieve precision tolerances in machining radioactive materials. The General Electric engineers have installed a closed loop servomechanism system, developed by Lear Inc., on a Hardinge lathe so that all normal hand operations can be carried out from a remote station with the operator shielded by lead or concrete walls. Servomechanisms are installed on both the compound and cross-feed motion, with a third on a milling attachment. Machine tolerances within 0.001-inch are possible with the system.

Air Flotation Segregates Parts Into Size Groups

PRIOR to a gaging operation of fabricated mica parts at the Brooklyn plant of Ford Radio & Mica Corp., the stamped parts are segregated into over, normal, or under-size groupings by a novel air flow classification system. Stamping and other fabrication operations on mica may cause undesirable splitting to thinner parts than required. The company uses electronically-controlled air blowers to provide a regulated stream of air calculated to float mica pieces to respective classification bins. The bin into which a piece will be carried depends on the weight of the piece, a direct indication of its thickness. Air flow and velocity, and other factors which vary according to the quality and grade of mica used have been accurately established for over 4000 different stamped mica products. The combined gaging and flotation system

Second Manufacturing Automation Conference Plans Set—Balanced Program Arranged

Congressman Patman To Be Banquet Speaker

THE Second Conference on Manufacturing Automation, co-sponsored by Purdue University and AUTOMATION magazine, is scheduled to meet on the University's campus October 7, 8 and 9. The organization of the conference reflects the planning committee's interest in designing a worthwhile event which really satisfies the definition of a conference—a formal consultation or discussion, a meeting for the interchange of views. Far too many conferences fail to provide adequately for "the interchange of views"—a failing which the arrangements of the Purdue conference are designed to overcome.

Session topics to be covered by industry experts in formal sessions include: *Planning Automatic Line Production, Developing the Integrated Line, Estimating Special Equipment Costs, Comparing Machine Cost and Time Factors, How to Figure Payoff, Gaging Control, Process Control, Numerical Control, Automatically Handling Parts in Process, Economics of Automatic Assembly* and *Orienting and Placing Small Parts for Assembly.*

A legislator's view of automation will be given at the conference banquet by the Honorable Wright Patman, Member of Congress from the 1st Congressional District of Texas. Congressman Patman is a ranking member of the Committee on Banking and Currency of the House; Chairman of the House Committee on Small Business; member of the Joint Committee on Defense Production; and Chairman of the Joint House and Senate Committee on the Economic Report and Chairman of its Subcommittee on Economic Stabilization. It is in this last capacity that Congressman Patman has held hearings on automation, and in this position he has had the opportunity to discuss the broad aspects of the problem with many leaders of industry in defining the national implications of the technology.

Typically, the conferees at the formal phase of the conference will be given an opportunity to ask questions from the floor but the ideal climate for "interchange of views" will be created in that part of the conference devoted to round-table discussions. The afternoons of October 8 and 9 have been set aside for various round-table discussions in which the final setup of the groups will be keyed into a consensus of the conferees' interest insofar as practical. Tentatively, it is planned that the areas to be covered will be taken from this list: Management, organization, machine cost, press loading, transfer machine, turning, parts feeding, gaging, bulk feeding, banking, resistance welding, automatic assembly, instrumentation, static control, numerical control, electrical control, testing, packaging, and mechanical handling.

Automation is a broad and complex theme, but certainly the Second Conference on Manufacturing Automation to be held at Purdue on October 7, 8 and 9 contains that balance of subjects and that type of coverage which results in increasing the general level of appreciation and understanding of a subject of such vital interest and importance to American industry.

Never a holdup or slowdown to lubricate this tube reducer in Michigan auto factory

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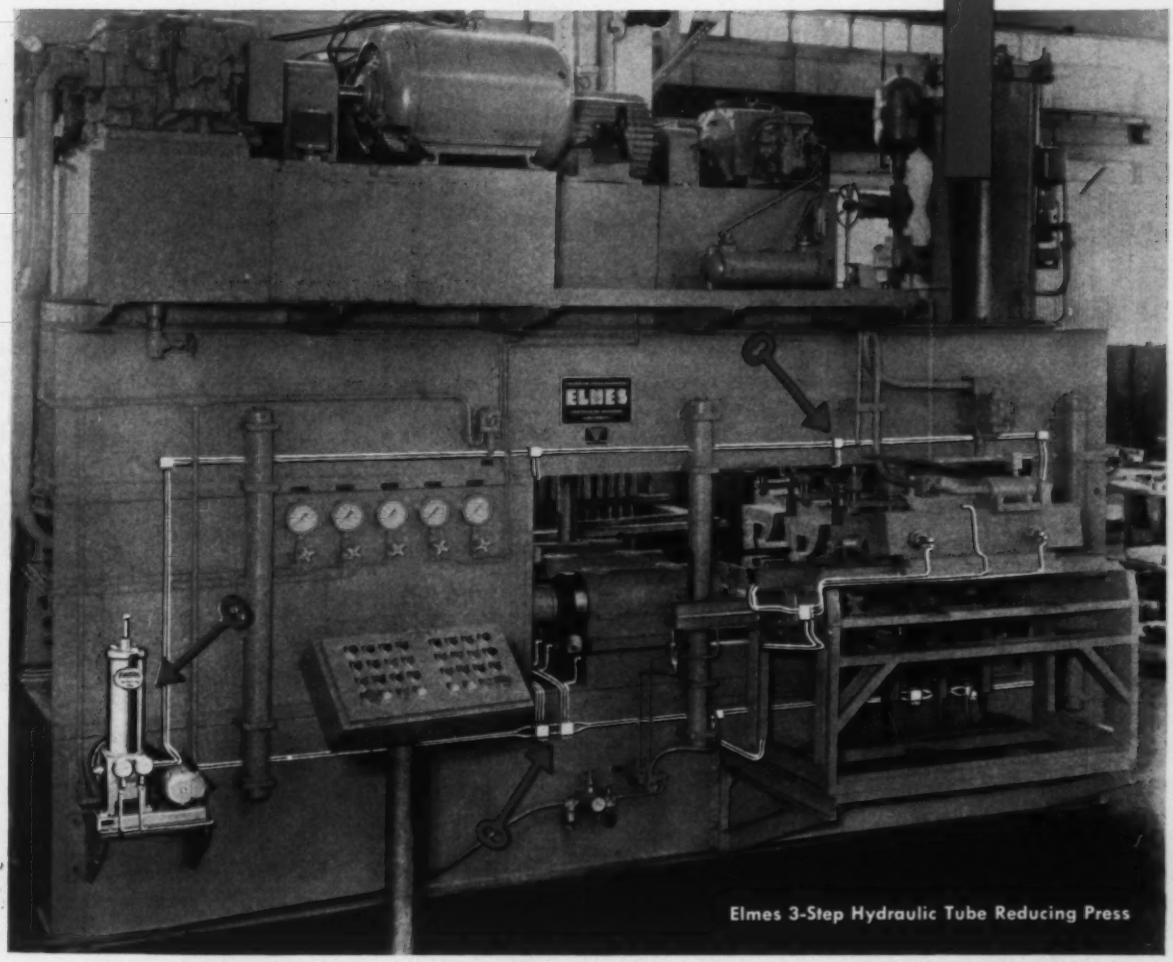
Studies in Centralized Lubrication
No. 203



Elmes 3-Step Hydraulic Tube Reducing Press

● With automation, centralized lubrication is a must. What automated line can afford to slow down or shut down because a forgotten bearing has run dry?

Equipped with Farval, any machine can operate continuously, day and night, with never a pause for lubrication nor a shutdown for a burned-out bearing.

Farval delivers a measured amount of clean oil or grease to every bearing served, at any desired, predetermined interval. No bearing is ever missed—and the amount of lubricant delivered to any one bearing can be varied without affecting the rest of the system. Guesswork and hit-and-miss hand oiling are eliminated with Farval.

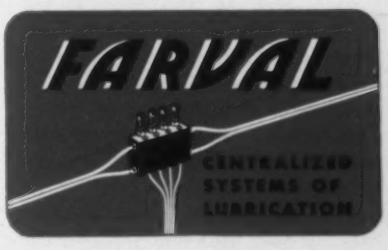
A Farval Centralized Lubrication System, manual or automatic, is easily designed into any machine. Let us send a representative to discuss application of Farval to your equipment. Drop us a line. Also ask for Bulletin 26-S. The Farval Corporation, 3265 East 80th Street, Cleveland 4, Ohio.

Affiliate of The Cleveland Worm and Gear Company, Industrial Worm Gearing. In Canada: Peacock Brothers Limited.

KEYS TO ADEQUATE LUBRICATION—

Wherever you see the sign of Farval—the familiar central pumping station, dual lubricant lines and valve manifolds—you know a machine is being properly lubricated.

This *Farvalized* machine is an Elmes 60-ton Tube Reducer. In three steps it reduces tubing for drive shafts for a well-known Michigan-made automobile.



Circle 659 on Inquiry Card

DEVELOPED under an Air Force contract, an extremely flexible electronic computer distinguished by its low power and small size has been described by Bell Telephone Laboratories. Compared with previous computers, the unit operates with a considerably reduced number of components. Excluding its magnetic cores, it uses only about 9000 components. More than half of these are transistors, and this makes possible the small size and low power requirements of the computer. The unit can be used as a test model for research on digital computers in that the components can be reconnected to simulate a desired design without building new equipment. In addition to the flexibility which enables the computer to be used in the building of prototype computers, unit demonstrates the feasibility of direct coupled transistor logic which is a switching circuit technique in which transistors are used to perform logic operations as well as to provide power.

classification is applied to parts ranging in thickness from 0.006 to 0.015-inch. Tolerances are within $\pm$0.002-inch and the accuracy of thickness classification by air flow results in better than 95 per cent of production being separated to within the 0.002-inch thickness tolerance required.

Post Office Unveils First Letter Sorter

FIRST automatic mail sorting machine in the United States postal service has been officially placed in regular operation. Following several months of testing and operator training, the machine, called a "Transorma," was formally turned over to the Post Office Dept. by **Walter H. Wheeler Jr.**, president of Pitney-Bowes Inc. in a ceremony attended by members of the Senate and House Post Office Committees, Department officials and officers of postal workers unions.

The machine is about 50 feet long, 10 feet wide and 7 feet high, with five operators seated at individual keyboards on a top deck. At present, each operator can mechanically sort 3000 letters an hour, by touching symbol keys for 300 chutes representing different destinations or routes. A clerk sorting by hand can sort only 1000 to 1500 letters an hour, and then only for 75 different pigeon holes or destinations. The machine sorting area is arranged in banks of numbered pigeon holes which can be conveniently emptied by postal workers as the work progresses. The machine sorts incoming or outgoing mail at the same time.

Boring and Facing Tool

COMBINED boring and spot facing tools, with throw-away blanks for both operations, are available from Wesson Co. The boring blank is micro-adjustable, a feature which provides a positive adjustment for diameter. The dial head of the adjustment screw is calibrated so that every graduation is equal to 0.001-inch on diameter; once adjusted, there is

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with these packaged, on-the-shelf P&W Air-O-Limit Light Signal Units. Can be used to signal operator or to provide feed-back impulse for fully automatic process control.

BASIC 2-LIMIT UNIT . . . indicates high and low tolerances. Suitable for sorting and other "yes-or-no" control applications.

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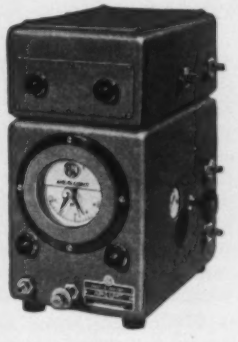
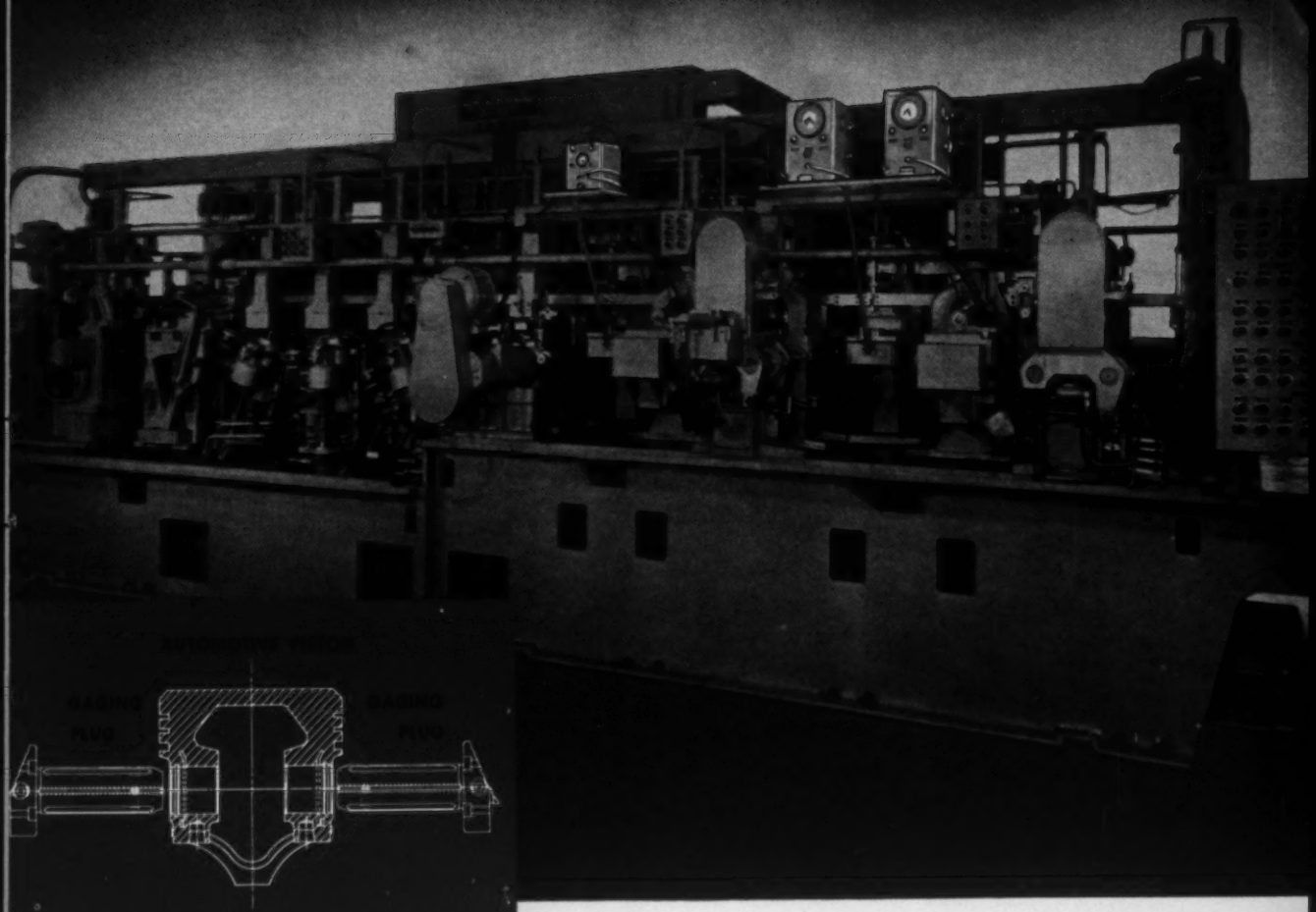
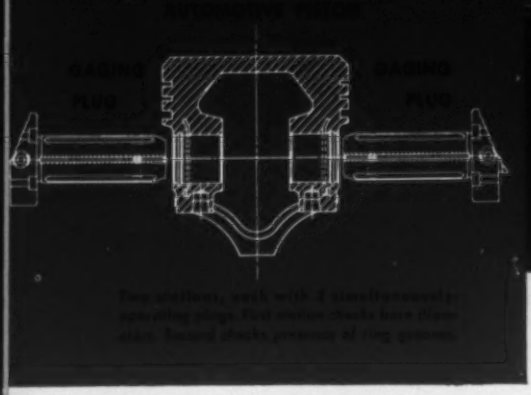


4-LIMIT UNIT . . . similar to 3-Limit Unit, but provides greater control scope. Indicates or controls such conditions as: "Approach High Limit," "High Limit," "Approach Low Limit" and "Low Limit."





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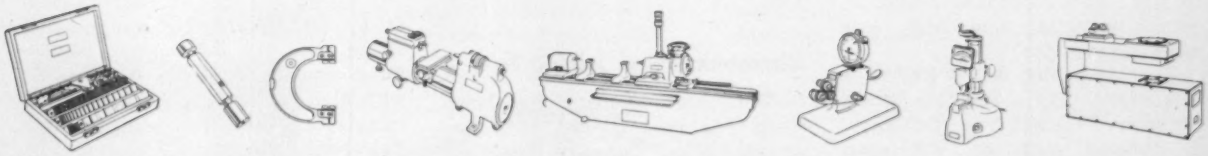
WITH PRATT & WHITNEY STANDARD, ON-THE-SHELF GAGE CONTROL UNITS

INCREASED OUTPUT RATES, INSURED ACCURACY, REDUCED REJECT LOSSES . . . are the benefits you get with On-Machine Automatic or Automation Gaging! And now, these standard P&W Packaged Units . . . with appropriate tooling . . . can provide an installation tailored to your needs *without* the expense or delays required to engineer and construct special controls.

For example, these P&W Packaged Units made it easy to provide automatic on-machine gaging for this special, high-speed automotive piston machine produced by LaSalle Tool, Inc. Two P&W Air-O-Limit Carbide Gage Plugs are arranged to check the ID of both wrist pin bores on the pistons automatically. Lights on the P&W Control Units signal the operator if tolerances are exceeded. A second set of gage plugs similarly checks bores for the presence of snap ring grooves. If desired, control units can be arranged to shut down the machine automatically when an imperfect part is detected. Whatever *your* requirements, P&W can supply gaging equipment exactly right for the job.

For complete information, write to Pratt & Whitney Company, Inc., 35 Charter Oak Boulevard, West Hartford, Connecticut.



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usually no need for any further re-setting of the tool. When one edge is dulled, the blank is merely indexed to a new cutting edge. Tool grinding is eliminated since the blank is replaced when all edges have been used.

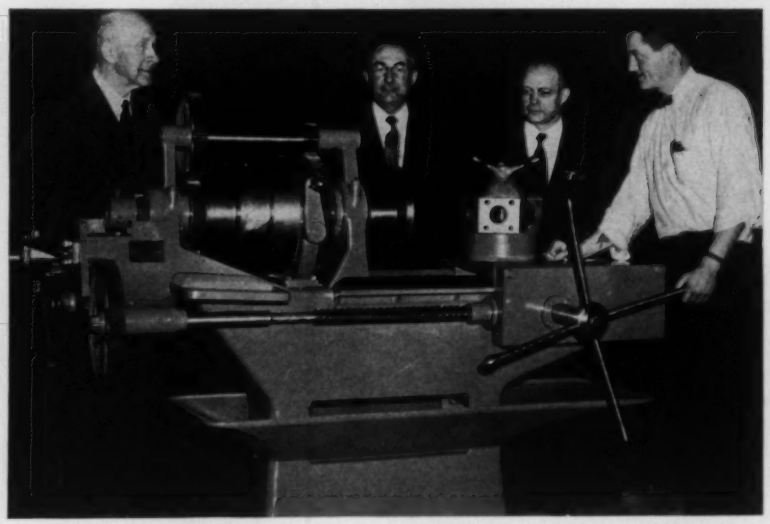
Expect Cleveland ISA Meeting To Set New Attendance Record

BEGINNING with a handful of instrument people in 1946, the Instrument Society of America now boasts more than 10,000 members. The annual conference and exhibit sponsored by the society has, during the same period of time, become one of the ten largest national occasions of its type. Increased interest in the Society's activities are a measure of the important role instrumentation occupies in the overall automation picture.

The Society's 12th Annual Instrument-Automation Conference and Exhibit will take place in Cleveland, September 9-13. There is every indication that it will live up to its reputation as the number one show in the field of instrumentation. Items: Some 500 industrial exhibits will depict the latest developments in the field; approximately 100 papers will be presented in a series of technical sessions; and special clinics will augment the educational phase of the program.

Several of the clinics or workshops are scheduled for Saturday and Sunday (September 7-8) preceding the opening of the conference and exhibit. Areas scheduled for coverage by special workshops include data handling, maintenance, systems, computers, and sales engineering.

The conference period has been established with a separate theme for each of the scheduled five days. A national authority will open each day's session with a keynote talk. The themes are: Monday, Introductory Session; Tuesday, Research and Development; Wednesday, Performance and Application; Thursday, Economics; and Friday, Summary Session. With the conference scheduled to include discussions of topics suited to the specialist as well as the man with a general interest in instrumentation, and considering the large numbers of exhibitors, it is apparent that the conference should benefit all who attend.



SMITHSONIAN INSTITUTION is establishing a Hall of Tools which will reflect the importance of the machine tool industry and its contributions to the development of our industrial society. One of the contributions to the permanent exhibit is an 1889 model turret lathe, one of the first manufactured by the Gisholt Machine Co. Shown with the machine prior to its shipment to the Smithsonian are: (left) G. E. Gernon, company secretary who in his youth sold and serviced this type of machine; George M. Class, vice president; Alfred G. Hoffer, works manager; and R. F. Johnson, assistant to the president Gisholt Machine Co.

MANAGER OF operations, **H. M. Ross** has announced the appointment of **George F. Crosby Jr.** as manufacturing manager, Robins Conveyors Div., Hewitt-Robins Inc. Crosby will be responsible for the functions of production control, stores, shop ordering, methods and production design, and manufacturing. He succeeds **Edward J. Mytkowicz** who was recently appointed manager of operations of the company's Jones Machinery Div.

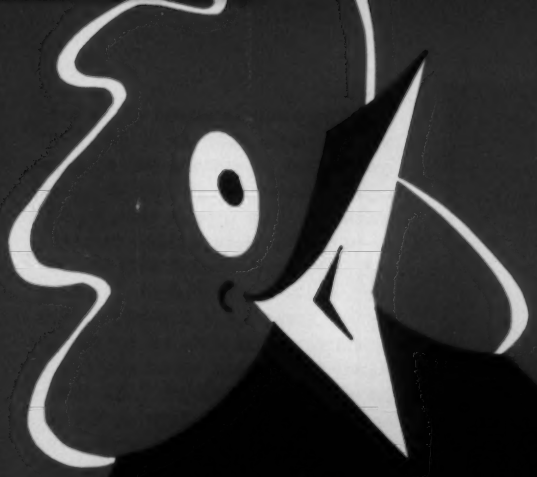
Ultrasonic Metal Joining Firm

SUBSIDIARY company, Sonobond Corp. has been formed by Aeroprojects Inc. The new company will manufacture, sell and service ultrasonic metal joining equipment that Aeroprojects has developed. The new company will devote its efforts to assisting industry in the use of three lines of ultrasonic metal joining equipment: ultrasonic non-fusion welding equipment, ultrasonic fluxless brazing equipment, and ultrasonic fluxless soldering equipment.

In ultrasonic non-fusion welding, metals and alloys are joined by vibratory energy with a resulting weldment characterized by lack of a fusion zone, low external deformation, and high strength. The technique is capable of joining extremely thin foils, very small wires, and other objects and has already been developed to the point of accomplishing continuous-seam welds and spot type welds in metals such as aluminum and copper and ranging in thickness from 0.0002 to 0.030-inch.

Auxiliary Telephone Device For Rapid Data Transmission

DATA TRANSMISSION equipment which uses the information handling capacity of telephone circuits with high efficiency (1000 words a minute) has been developed by Bell Telephone Laboratories. Tentatively called a "data subset," equipment is designed to give accurate transmission of data originating among wide varieties of information processing machines, such as computers, electric typewriters and adding machines. Voice communication can precede or follow the op-



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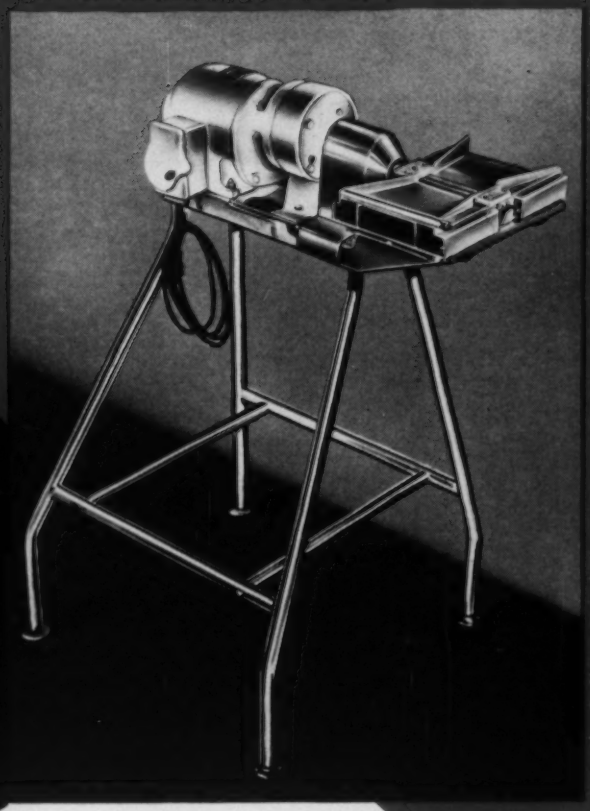

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ANOTHER DRIVE REQUIREMENT MEETS ITS MASTER

"But my drive problems are different," you say, and right you undoubtedly are. Far as we know, this Master-powered Gizzard Skinner is unique.

But here's the point. America's productive genius consists of the ability to analyze a problem, devise a system and apply power to it in such a way as to produce better results faster at less cost. And *that problem* we bet you've got!

Let us help! Tell us the problem. From the drives listed here—or a combination of the required ones in one compact efficient unit—we'll deliver the goods! That's just what we've done for many, many years, to an ever-enlarging cross-section of American industry jealous of the performance of their motor equipment.

Motor Ratings..1/8 to 400 H.P. All phases, voltages and frequencies.

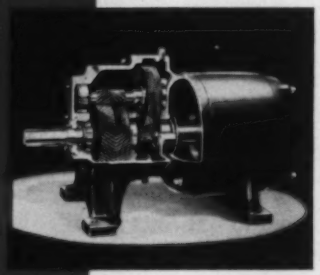
Motor Types.....Squirrel cage, slip ring, synchronous, repulsion-start induction, capacitor, direct current.

Construction.....Open, enclosed, splash-proof, fan-cooled, explosion-proof, special purpose.

Speeds.....Single-speed, multi-speed, and variable speed.

Installation.....Horizontal and vertical, with or without flanges and other features.

Power Drive Features.....Electric brakes (2 types)—5 types of gear reduction up to 432 to 1 ratio. Mechanical and electronic variable speed units—fluid drives—every type of mounting.



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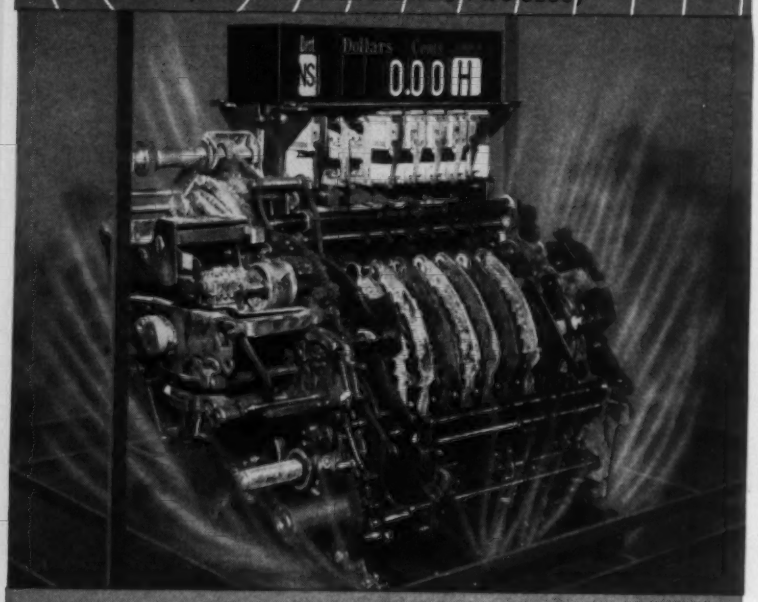

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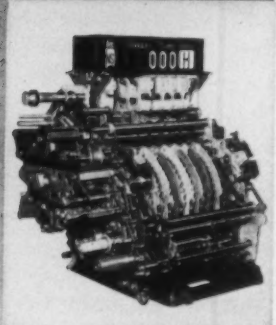

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The present prototype model is about the size of an office typewriter but the unit when finally modified after further laboratory studies will probably be considerably smaller. Not only does the machine reduce drastically the amount of time a telephone would need to be used to transmit complicated data or large quantities of data but equipment can be set up to function in off-peak telephone traffic hours.

APPOINTMENT of **Ricardo Muniz** as co-ordinator of manufacturing and engineering has been announced by **Leonard F. Cramer,** vice president and general manager, Television-Radio-Phongraph Div. of the Magnavox Co. Muniz comes to Magnavox from Canadian Westinghouse where he served as division general manager of their Television-Radio division.

Standards Committee Works On Automatic Control Terminology

UNDER American Standards Association procedures, Sectional Committee C85 has been constituted to establish standard terms pertaining to automatic control and to develop definitions of such terms. The sponsor of the project is the American Society of Mechanical Engineers. The project will be concerned with terminology pertaining to systems such as: automatic process control, feedback control, regulating and other related systems not requiring human intervention as part of the regulating procedure. **M. A. Princi,** General Electric Co., is chairman of the committee.

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418	448	478	508	538	568	598	628	658	688	718	748	778	808
419	449	479	509	539	569	599	629	659	689	719	749	779	809
420	450	480	510	540	570	600	630	660	690	720	750	780	810
421	451	481	511	541	571	601	631	661	691	721	751	781	811
422	452	482	512	542	572	602	632	662	692	722	752	782	812
423	453	483	513	543	573	603	633	663	693	723	753	783	813
424	454	484	514	544	574	604	634	664	694	724	754	784	814
425	455	485	515	545	575	605	635	665	695	725	755	785	815
426	456	486	516	546	576	606	636	666	696	726	756	786	816
427	457	487	517	547	577	607	637	667	697	727	757	787	817
428	458	488	518	548	578	608	638	668	698	728	758	788	818
429	459	489	519	549	579	609	639	669	699	729	759	789	819
430	460	490	520	550	580	610	640	670	700	730	760	790	820

AUTOMATION AUGUST 1957

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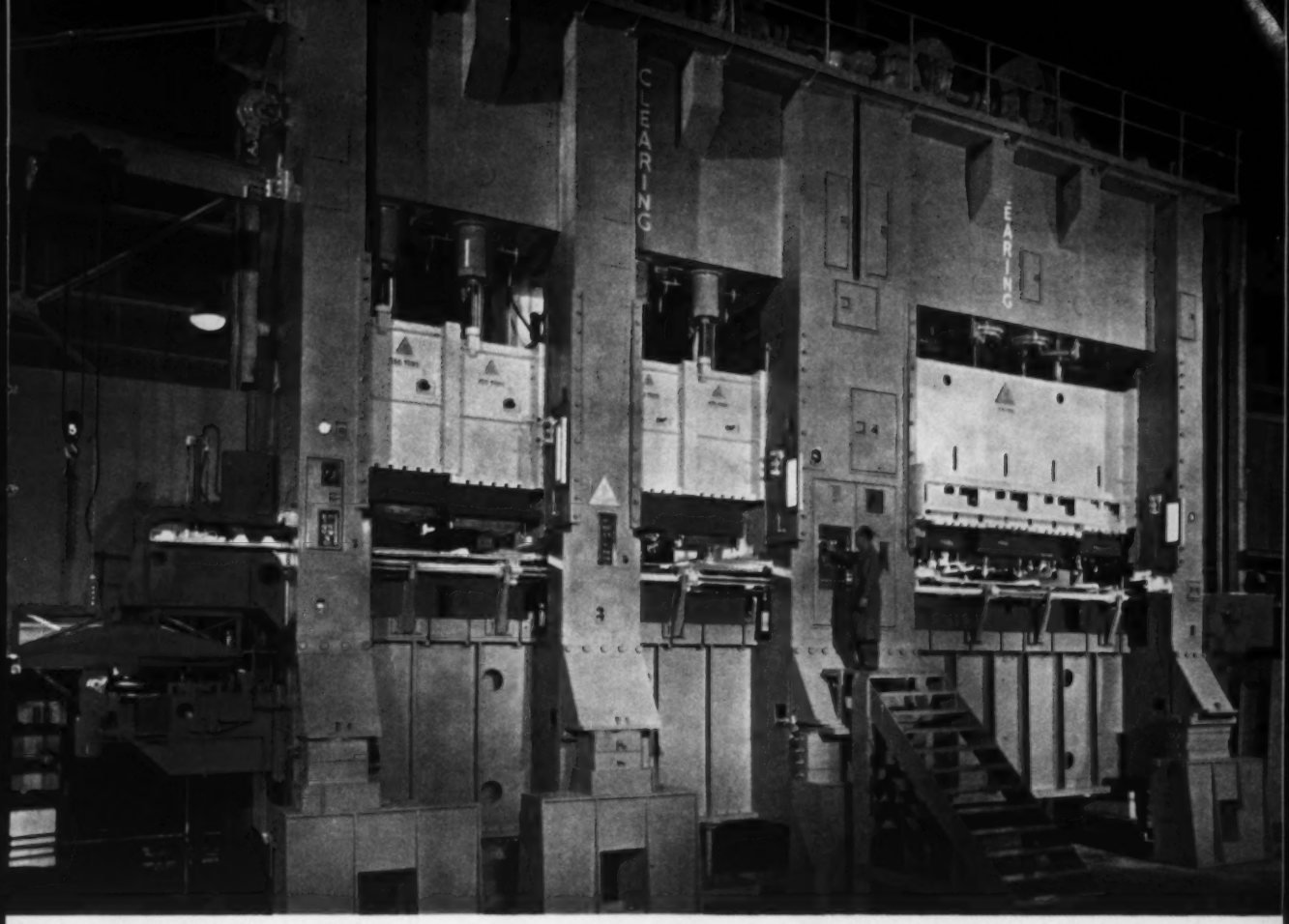

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its work, the group has set up several subcommittees, each being assigned a certain work area which will be covered in the initial document which C-85 plans to publish. The subcommittees and their work areas are as follows: Subcommittee 1—Types and Components, chairman **H. A. Miller,** Raytheon Manufacturing Co.; concerned with definitions which describe the basic types of automatic control systems and the various component elements of each system. Subcommittee 2 — Signals, chairman **D. H. Smith,** Bell Telephone Laboratories; concerned with defining the signals and process variables which are present in a generalized feedback control system. Subcommittee 3—Modes and Parameters, chairman **W. I. Caldwell,** Taylor Instrument Cos.; concerned with terms describing automatic control action, and the fixed or adjustable parameters which influence control action. Subcommittee 4—Behavior and Presentation, chairman **Dr. H. L. Mason,** National Bureau of Standards; concerned with terms describing in detail the responses of automatic control systems, and their generalized controlled elements.

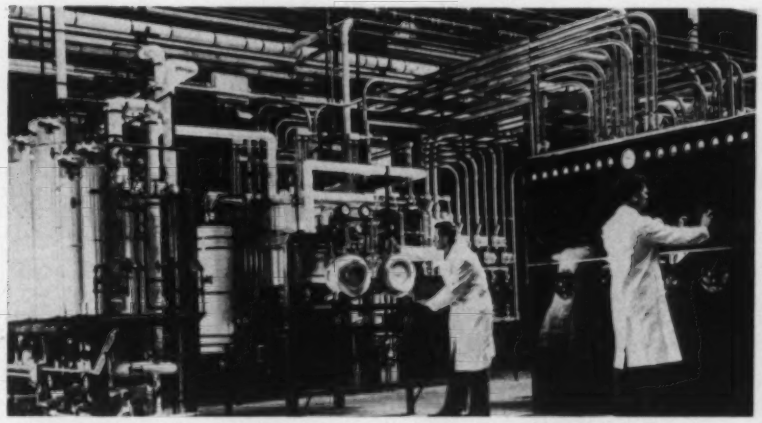
A number of meetings of the main committee and of the subcommittees have been held, and some 200 terms have been defined tentatively. It is anticipated that these definitions will be distributed for comments in the near future.

Distributors Study Electronics As Industrial Uses Expand

SPECIAL committee has been appointed by the National Association of Electrical Distributors to study developments in the industrial electronics field. The committee will report on information which would be helpful to the membership of the association in the wholesale distribution of electronic parts.

The increasing importance of electronics in the field of industrial controls is expected to become a major factor in electronics distribution in the near future. Many full-functioning electrical distributors presently are engaged in stocking electronic tubes and

Circle 664 on Inquiry Card



TRANSLATING research results into productive reality for chemical manufacturers is the self-appointed job of the Lummus Co. The concern has provided itself with basic building blocks used in chemical and petroleum plant design which enable typical unit operations to be proved out. Variety of equipment which can be interconnected for unit operation studies includes means of heating and cooling, distillation, fractionation, contacting, filtration, and solvent extraction; unit processes which can be studied include oxidation, reduction, catalytic cracking esterification, hydrogenation, and polymerization.

parts in order to better serve their industrial accounts. A great many other electrical distributors are reported to be seriously considering adding this equipment to their lines.

FORMATION of a Power and Package Unit Div. has been announced by Racine Hydraulics & Machinery Inc. **George Verhaeghe,** formerly chief sales engineer of the parent company, is the division manager. With the formation of the new division, more emphasis will be placed on the design and production of power units and, in particular, the engineering of complete hydraulic and electrical systems in compact custom-built units.

Computing Machine Output Converted Into Verbal Form

SYSTEM which can convert commands from computing machines into verbal messages has been developed by the Electronics Div. of Fairchild Controls Corp. Important applications for the device are in air traffic control, airborne early warning systems, remote voice communications, information directories in airline and railroad terminals, and multi-lingual communications.

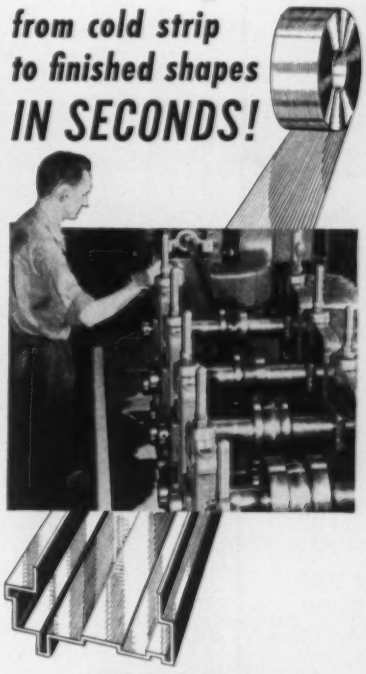
The basic system consists of vocabulary storage, word sequence control, programed sampler and input control units. The input control units are tailored to meet the requirements of specific applications. The vocabulary storage unit is the heart of the system and consists of a rotating magnetic drum and set of recording-playback heads. A basic message format is set up within the system so that control signals are required only for the variable parameters within the formats. Any number of message formats and message lengths may be obtained by proper programing of the system.

As an example of its use, teamed with an air defense electronic data processing system such as SAGE, the new voice system can provide completely automatic guidance control of aircraft using existing communications facilities. The stored vocabulary would contain all of the words necessary to command an aircraft on an intercept mission. As the basic data processing system computes the best course and altitude for an intercept, the voice system transforms this information into the form of a verbal message which can be transmitted to the aircraft using the standard voice channel transmitter.

Improved Office Switchboard

CORDLESS switchboard has been developed by Bell Telephone Laboratories for businesses needing twenty to sixty telephones and ten or less central trunk lines. An ex-

from cold strip to finished shapes IN SECONDS!



YODER ROLL-FORMING MACHINES

If you are in the business of manufacturing a product that is, or could be, made wholly or partly from flat rolled metals in thicknesses up to ½", a Yoder Roll-Forming machine can help reduce your production costs.

Cold-formed shapes of every description —including structurals, tubular products, moldings, trim, roofing and siding, panels, cabinet shells, etc., can be produced on Yoder cold-roll forming equipment at the rate of 25,000 to 50,000 feet per day at a conversion cost of only a fraction of a penny per foot! With speeds and costs such as this, even part-time operation of a Yoder roll-forming line is a profitable investment!

Additional operations such as welding, coiling, ring forming, perforating, notching, embossing or cutting to length can be simultaneously introduced to the basic shape at little or no additional labor cost. Yoder engineers are at your service in explaining the advantages of roll-forming for your individual needs.

A new, revised, Fifth Edition of the Yoder Cold-Roll Forming book is just off the press. In addition to economic and mechanical possibilities of cold-roll forming, it contains numerous illustrations of end uses and applications of roll-formed shapes. Write for your copy today.

THE YODER COMPANY
5526 Walworth Ave. • Cleveland 2, Ohio

ENGINEERING YODER MANUFACTURING
COLD ROLL FORMING MACHINES

Circle 665 on Inquiry Card

Ask Standard

how to cut costs with conveyors

Standard limit-switch-controlled Automatic Reciprocator is one of two used to form 200-ft. overhead detour of dehumidifier assembly line.

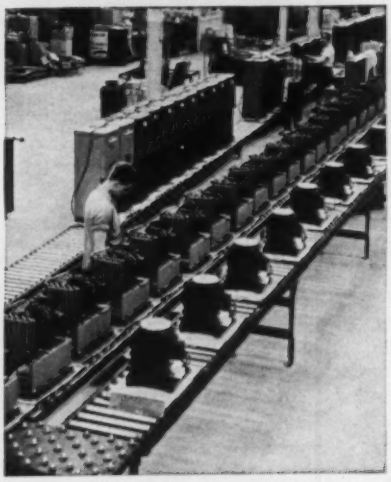
"COMPLETE CONVEYORIZING" . . . what it did in a smaller plant

Products at Ebco stay on conveyors until packaged and sent to shipping.

Ebco Manufacturing Company — employing 275 people to produce water coolers, beverage dispensers and dehumidifiers — has realized substantial savings by completely conveyorizing their operations. Ebco engineers planned for an orderly conveyor system when developing plant layout and building design; consequently conveyor system costs were kept "low" and resulting efficiency is "excellent."

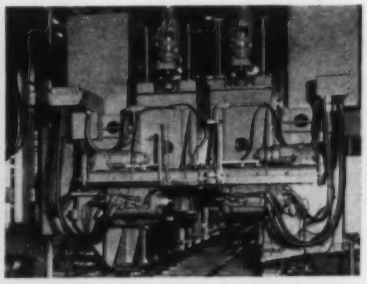
Similarly, it will pay you to take another close look at your present conveyor system. Standard specialists will be pleased to help you make evaluations . . . recommend the proper equipment and its application to meet your specific needs.

STANDARD CONVEYOR COMPANY, North St. Paul 9, Minnesota. Sales and Service in Principal Cities.



Gravity roller conveyors like this, used for Ebco's assembly lines, are inexpensive, easy to set up, and economical to maintain.

For details on Standard Conveyors of all types, contact the Standard representative listed in your classified phone book or write direct. Ask for Bulletin EE-8.



AUTOMATIC contour or spar mill has been developed by Onsrud Machine Works Inc. to produce structural wing members for the Martin SeaMaster seaplane. The milling machine is 96 feet long and contains two carriages housing cutter motors. The illustrated No. 2 carriage contains four liquid cooled cutter motors including two 100-hp induction motors. Cutters on each of these latter two motors are capable of two electronic tracer controlled feeds—transverse and vertical rise and fall. The remaining two motors, 60-hp each, are capable of three electronic tracer controlled feeds—vertical rise and fall motion and twist motion under common control and transverse feeds independently controlled.

perimental unit has been in operation at the Horn Ohio Co. for approximately a year. The office communication system containing the new switchboard device is notable in that it does away with the tangle of cords and plugs normally found on PBX switchboards. The switchboards console occupies only a small space on a desk and the switching equipment is contained in two cabinets which can be located at some other convenient point.

A unit contains several unique features including a "camp-on" provision which permits one incoming call to a busy station to be held and automatically cut into the station as soon as it is free. The unit provides for automatic disconnect when calls are ended; a conference circuit for five stations; and a dial paging arrangement from all stations—features which require only about ⅓ as much of the attendant's time as it needed to operate the conventional switchboard.

Trailer Mounted Pump Station

UNIQUE pipeline control system will be installed at an unattended satellite pump station located on an oil line in Saudi Arabia. Part of the system equipment was de-

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Cracked shaft in Valdosta... His job: get a new one down to Georgia by tomorrow noon. It's an emergency case, but it's not as tough as it sounds.

He's backed by the press industry's largest parts department... by a million dollar parts inventory in two plants... by telephone and teletype tie-ups between Parts Headquarters in Hastings, Michigan and Toledo and local sales and service centers throughout the country.

Which is another reason why we say, "Bliss is more than a name... it's a guarantee."

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E. W. BLISS COMPANY · Canton, Ohio

100 years of making metal work for mankind

PRESSES • ROLLING MILLS • MILL ROLLS • DIE SETS • CAN MACHINERY • ORDNANCE

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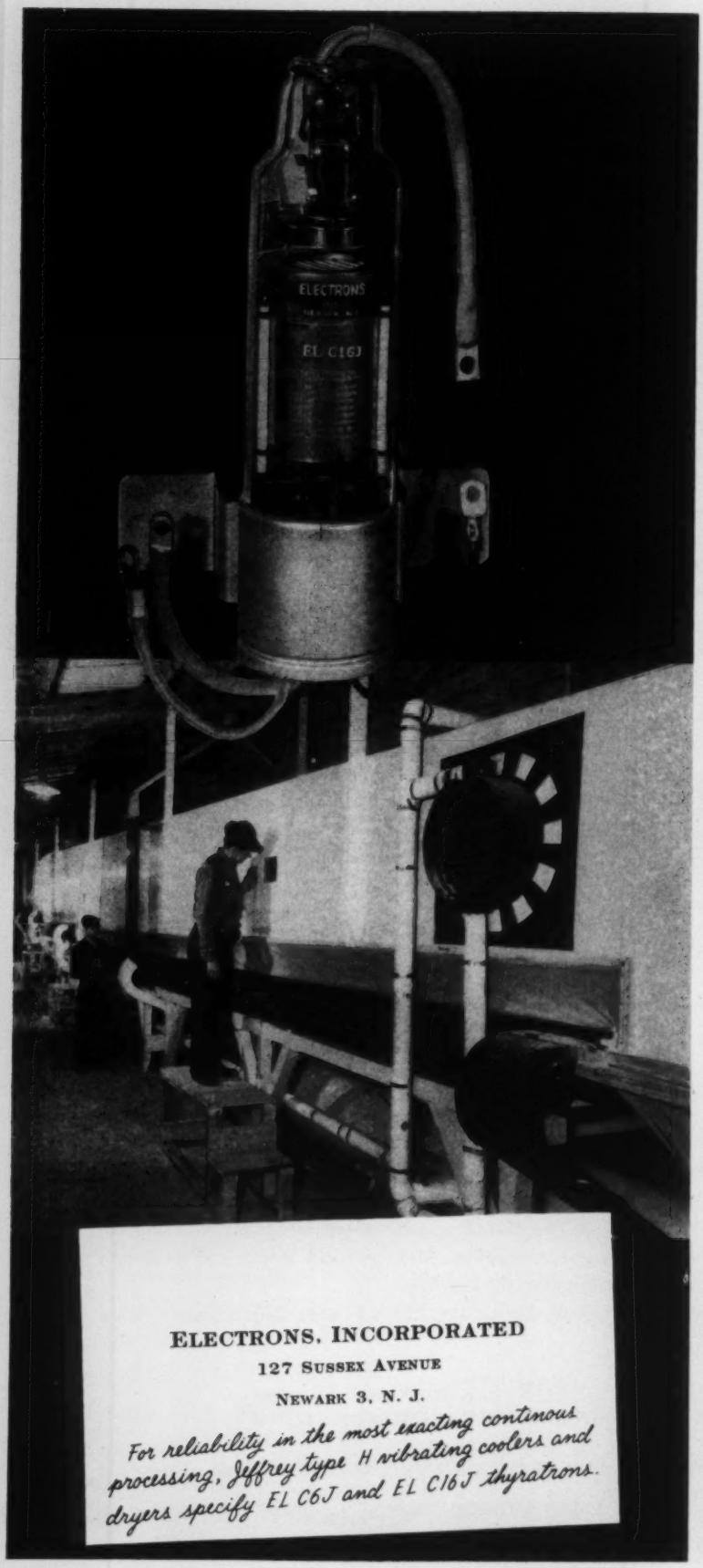
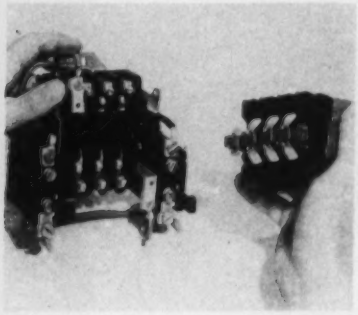


ELECTRONS, INCORPORATED
127 SUSSEX AVENUE
NEWARK 3, N. J.

For reliability in the most exacting continous processing, Jeffrey type H vibrating coolers and dryers specify EL C6J and EL C16J thyratrons.

signed and manufactured by Union Switch & Signal, Div. of Westinghouse Air Brake Co. The installation will be unique in that the pump station and its associated equipment will be housed in three mobile vans as a package unit.

A centralized control system including electrical instrumentation, data processing unts, tone shift terminals, UHF radio equipment and control and monitoring equipment will be located in one trailer operating in conjunction with a 5000 hp gas turbine, a crude oil pump, combustion air filtering equipment, measuring instruments, turbine sequence control and generator housed in two other vans. Information transfer between the pump station and a base control point will be by UHF radio facilities which also provide a voice channel for communication between the base point and an inspection or maintenance crew which might be at the satellite location.



NEW LINE OF NEMA size 0 and 1 magnetic starters has been introduced by General Electric Co. An individual starter is approximately 42 per cent smaller than previous forms of similar ratings. Design of starter simplifies routine inspection of contacts and starter maintenance since principal components snap or slide together. Maintenance can be performed without using tools. As shown, redesigned vertically slanted contacts are used with a resultant higher tip pressure that reduces the possibility of contact welding.

Improved Infrared Detectors

INFRARED detectors equipped with optical parts made from a silicon material permit the detection of heat below the range of similar devices equipped with quartz, sapphire and other materials now used in optical filters. As announced by Raytheon Mfg. Co. the improved silicon optical parts will permit the design of

Circle 668 on Inquiry Card

*CCC on-the-job address: ANYWHERE, U.S.A.

From the seaboard to the Ozarks, from the automobile plants of Michigan to the great steel producing centers, Commercial Contracting Corporation is known for important installations of automated and other manufacturing equipment.

The world's largest producers of automobiles, steel and aluminum rely on CCC. More than a billion dollars' worth of vital machinery has been entrusted to the experienced hands . . . to the practical planning and skilled supervision of the CCC organization. No job is too complex for these experts.

Commercial Contracting Corporation specializes in precision installation of press plants, rolling mills, foundries, scrap collection systems, overhead cranes and other material handling equipment.

CCC's roster of satisfied customers reads like a bluebook of industry. If your company is planning an expansion or alteration program, CCC will do the job quickly, economically, efficiently . . . for CCC "has know-how, will travel."

Write for complete information, without obligation.

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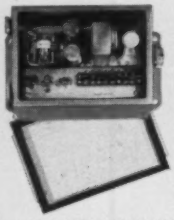
Now . . . "automate" operations with metal sensing transducers

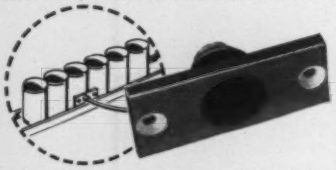
Control or count without contact



Proximity control unit in JIC enclosure for use with transducers shown. System detects ferrous and non-ferrous metals. For automatic production lines, multiple process machines, parts feeders, conveyors. Maximum rate 600 operations/minute. 4905-RAC $85.

Standard proximity pickup. Detects small metal objects at speeds down to zero. Use for automatic feed, etc. 4910-AN $16.50

Water and oil proof proximity pickup. 4910-WPN $45.00



Extended range proximity pickup with greater sensitivity than 4910-AN. 4915-AN $22.50.

Pancake proximity pickup. Detects large metal masses at greater distances than 4915-AN. 4925-AN $36.50.

Hollow coil proximity pickup. Use for control, batching, switching, automatic operation. Counts small and medium sized parts. I. D. ¼" to 3". 4920-AN $36.50.

See BOOTH 608, Instrument & Automation Show

Send for new Bulletin 1001

Electro — TRANSDUCERS FOR COUNTING CONTROL AND MEASUREMENT

ELECTRO PRODUCTS LABORATORIES

4501-U North Ravenswood, Chicago 40, Ill.

Canada: Atlas Radio Ltd., Toronto

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LANHAM ROLLAWAY JACK SYSTEM

FOR LIFETIME

From Skid-Type Storage to Truck-Type Hauling in a Jiffy!

WRITE FOR CATALOG NO. LR-57

THE LANHAM SKID CO.

716 Mississippi River • Keokuk, Iowa

LANHAM MAKES ALL KINDS OF SKIDS AND ALLIED PRODUCTS

Circle 671 on Inquiry Card

lightweight, simple infrared systems less complicated than other electronic systems presently in use.

In military applications, use of the new material will make it possible to detect enemy ships, planes and missiles from longer distances and will lead to more effective solutions of guidance, gunfire control and automatic tracking problems. In the commercial field, silicon optical parts, such as prisms, lens and windows can be used in devices to analyze petroleum products in refineries as well as in other chemical industries where spectrometers are used.

MEETINGS AND EVENTS

Aug. 19-23—

Symposium on Automatic Control. Sponsored by IRE Professional Group on Automatic Control, Instruments and Regulators Div. ASME, and Feedback Control Systems Committee AIEE. To be held Mark Hopkins Hotel, San Francisco. Additional information may be obtained from J. M. Jones, Hughes Aircraft Co., Bldg. 6, Mail Station 2344, Culver City, Calif.

Aug. 20-23—

Institute of Radio Engineers. Western Electronic Show and Convention to be held Fairmont Hotel, San Francisco. Additional information may be obtained from Wescon headquarters, 342 N. La Brea, Los Angeles 36, Calif.

Sept. 9-13—

Instrument Society of America. Twelfth Annual Instrument-Automation Conference and Exhibit to be held Cleveland Auditorium, Cleveland. Additional information may be obtained from H. S. Kindler, ISA, 313 Sixth Ave., Pittsburgh 22, Pa.

Sept. 17-18—

Radio - Electronics - Television Manufacturers Association. Symposium on Numerical Control Systems for Machine Tools to be held Ambassador Hotel, Los Angeles. Additional information may be obtained from RETMA, Room 650, 11 W. 42nd St., New York 36, N.Y.

Sept. 23-25—

American Society of Mechanical Engineers. Fall meeting to be held Statler Hotel, Hartford, Conn. Ad-

ditional information may be obtained from ASME headquarters, 29 W. 39th St., New York 18, N.Y.

Sept. 24-26—

Sixth Annual Industrial Electronics Symposium. Co-sponsored by IRE and AIEE, to be held Morrison Hotel, Chicago. Additional information may be obtained from AIEE headquarters, 33 W. 39th St., New York 18, N.Y.

Oct. 7-9—

Second Conference on Manufacturing Automation. Co-sponsored by Purdue University and AUTOMATION Magazine to be held Purdue University. Additional information may be obtained from the Editor, AUTOMATION, Penton Bldg. Cleveland 13, O.

Oct. 7-9—

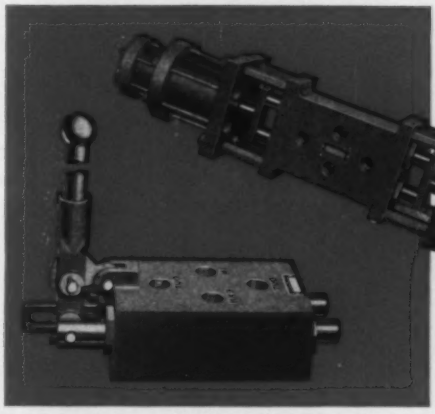
National Electronics Conference. Co-sponsored by Illinois Institute of Technology, AIEE, IRE, and Northwestern and Illinois universities. To be held Hotel Sherman, Chicago. Additional information may be obtained from Conference Secretary, Armour Research Foundation, 10 W. 35th St., Chicago 16, Ill.

Oct. 17-18—

National Conference on Industrial Hydraulics. Sponsored by Armour Research Foundation and Illinois Institute of Technology. To be held Hotel Sherman, Chicago. Additional information may be obtained from Conference Secretary, Armour Research Foundation, 10 W. 35th St., Chicago 16, Ill.

"Quick, cut off the power!"

Quick-As-Wink® HYDRAULIC VALVES



Double Pilot Cylinder Operated 3-position 4-way Hydraulic Valve

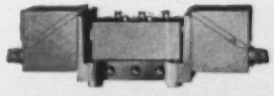
(At left) Lever Operated 3-position 4-way Hydraulic Valve

Hand and Pilot-operated Types for water or hydraulic oils to 5000 psi.

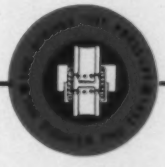
• These valves give users maximum efficiency, economy and dependability. Housings are milled from steel blocks or bronze forgings. The hollow, radially ported, stainless steel plungers are hard chrome plated and polished. Renewable metal valving rings assure long life of the packers which are expanded by internal pressure . . . the higher the pressure the tighter the seal. No metal to metal seating. The valves are fully balanced in any position. Inspection — and servicing if necessary — can be done easily *in the field,* avoiding the delays of returning valves to the factory for servicing, or the need to carry large inventories of standby valves — or even parts. Complete dimensions, capacities and other data sent promptly. Write for Bulletin No. 531,— Today!

Ask us also about . . .

CAM OPERATED SINGLE PLUNGER VALVE 3/16" to 3/4" sizes. Operated by rotating cam or land on reciprocating device.



DOUBLE SOLENOID "O-TYPE" VALVE for pressures up to 125 psi. Widely used as pilot valves and for operating air cylinders.



Quick-As-Wink® AIR AND HYDRAULIC Control Valves

Hand, Foot, Cam, Pilot, Diaphragm and Solenoid Operated

Mfd. by C. B. HUNT & SON, INC., 2071 East Pershing St., Salem, Ohio

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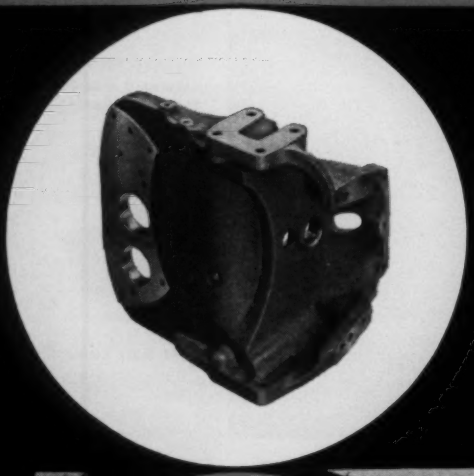

At Massey-Harris-Ferguson

Natcos Save 100 Parts...

Three multiple-spindle Natcos bore, drill, spotface and tap the front end support for a Massey-Harris-Ferguson tractor

NATCO

60 Man Hours Every

on Rugged Axle Support Castings

Massey-Harris-Ferguson checked it two ways. Nine general-purpose machines would do the job—or 3 Natcos. They chose the Natcos for these reasons:

- *Saving of $30,000 in machine cost*
- *Saving of 60 man hours every 100 parts*
- *Saving of 65% in floor space*

The Natcos handle all drilling, boring, spotfacing and tapping—a total of 67 operations on the 182-pound front axle casting. The casting is heavy, irregular—tough to fixture and clamp. The Natcos meet production requirement of 11 parts per hour.

Natco provided complete tooling which features automatic clamping, cycling and chip blow-out. All three machines are of unitized construction, giving Massey-Harris-Ferguson the flexibility to run different parts of redesigns of the same part.

Let Natco Field Engineers point out cost-saving and time-saving methods on your next drilling, boring, facing or tapping job. Natco offices are located in Chicago, Detroit, New York, Buffalo, Boston, Philadelphia, Cleveland and Los Angeles; distributors in other cities.

National Automatic Tool Company, Inc.

Richmond, Indiana

Multiple-spindle drilling, boring, facing and tapping machines. Special way-type, index and transfer machines.

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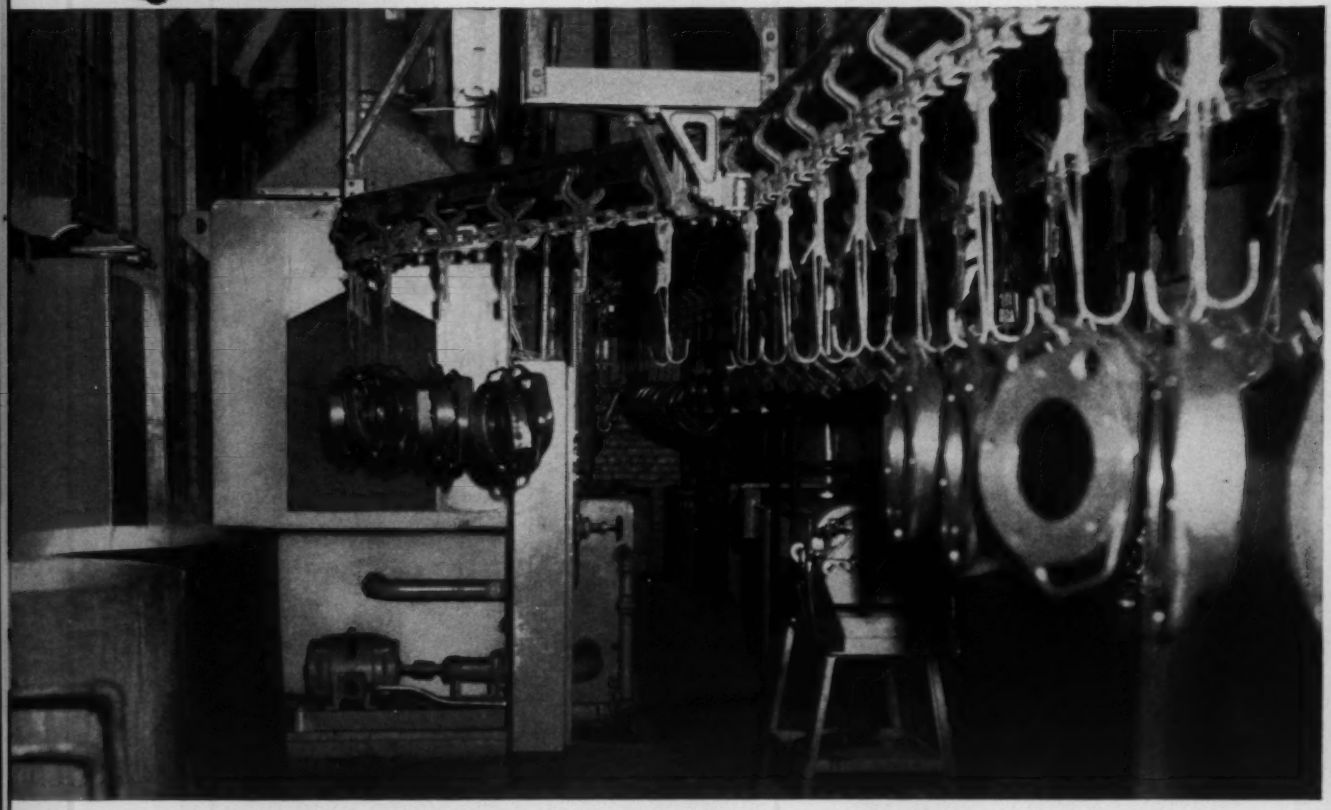
POWER SPRAY WASHERS

by PETERS-DALTON

Are Designed, Engineered, Built and Installed To Utilize Limited Plant Floor Space



Plant engineers are frequently faced with serious limitations of available space when searching for locations to install greatly needed production equipment. Problems such as these are met daily by Peters-Dalton. More than a quarter century of designing, engineering, fabricating and installing finishing equipment has qualified P-D to readily meet needs such as these.

The illustration here is of a P-D Gas Fired Single Stage Washer, designed to handle miscellaneous machine castings up to 35 lbs. in weight at a rate of 5000 lbs. per hour. The photograph clearly illustrates the careful planning required to make this important installation "fit," while still giving maximum productivity.

Why not send us your requirements, along with a layout of the area in which you plan an installation? Just write, wire or phone . . . we'll be glad to tell you more.

Representatives in principal cities.

- *Hydro-Whirl Paint Spray Booths*
- *Industrial Washing Equipment*
- *Drying and Baking Ovens*
- *Hydro-Whirl Dust Collecting Systems*

PD Peters-Dalton INC.
A SUBSIDIARY OF DETROIT HARVESTER CO.
17894 Ryan Road • Detroit 12, Michigan

By JAMES C. KEEBLER
Managing Editor

Ford's Part and Equipment Div. plant at Ypsilanti has this battery of machines that electronically test ignition distributors. Parameters of performance are pictorially displayed on 17-inch television type tubes for calibration by operating and quality control personnel. Equipment was developed and manufactured by Airborne Instruments Laboratory to Ford Motor Co. specifications.

Electrons, Isotopes & Engineers

"IT DIDN'T seem possible that the speed of common electrical switches and relays would ever be too slow, but now the one-third to one-half second necessary for an electrical switch to operate is a bottleneck in some production lines," says R. E. Mitchell, general master mechanic at Buick.

But even the seemingly impossible has a way of becoming a reality in the production of automobiles. Mitchell notes, however, that the problem is not without solution, "Modern electronic tubes provide the fastest, most accurate and smallest control units available in a production line. They give us the potential to get as much as four times more work out of some lines, along with an increase in accuracy and production standards."

Electron Invasion

These advancing electrons have not sneaked in without warning—nor have the predictions ceased. Ford's Andrew Kucher, vice president-engineering and research told the Detroit section of the SAE about a wonder world of the future in which electronic "brains" translate languages and metallurgists fill engineers' orders for new materials like pharmacists fill prescriptions.

Certainly the electrons are on the move. Yet the spectators are not all rooting for the same squad. There are still those in the back row that say these electrons will never replace the circular form-tool. These birds would give you to understand that although electrons are reportedly guiding missiles, figuring income taxes for large corporations, and keeping longhaired mathematicians from pulling their hair out—although they have a place in military aviation and fireside television receivers—they'll never make the grade on the factory floor. This attitude may be well founded.

Tool in the Trench

Obviously the circular form-tool is pretty firmly entrenched, but that doesn't mean that those who see ways of getting more work out of these electrons are all wild-eyed dreamers. These electrons have a lot of high-grade talent backing them and some real study is being put into their use in solving production problems.

Biggest inroads have been made in the fields of measuring and testing. This is a paradox because those who denounce the electronic age usually cite unreliability as being high on the list of disadvantages. This is proving to be a last ditch stand, however, since electronic devices are able to detect flaws that would otherwise have gone unnoticed.

Military electronics companies with a yen for civilian industrial markets have looked to production equipment as a fertile field. Many are the computer experts who have vied that come high water or anything else—sooner or later they were going to install computers right out there on the factory floor and let them take over the running of the shop. And despite the fact that IBM's Thomas Watson, Jr. assured Ed Murrow's television audience that computers don't really think, this factory floor full of computers might actually come to pass.

TV Guiding

From the looks of Ford's Ypsilanti Parts and Equipment Div. ignition distributor line, however, the television boys seem to have beaten the computer team to the punch. The operators can't pick up Tennessee Ernie's afternoon show but they can check and calibrate distributors to a high degree of accuracy.

The equipment developed and manufactured by Airborne Instruments Laboratory to Ford Motor specifications is used for the production-line testing of fully assembled distributors. The test displays the following important operational characteristics of a distributor: (1)

Dwell and dwell uniformity, (2) advance-angle-versus-speed, (3) firing uniformity, and (4) advance-angle-versus-vacuum.

Do Not Shake

Ford has also put the electrons to work dynamically balancing engines. International Research and Development Corp. developed the method on the basis of techniques they had formerly applied to solution of vibration problems in industrial machinery manufacture and maintenance, and in textile mills, chemical plants, petroleum processing industries, jet aircraft engines and frames, as well as submarine craft.

Once the amount of unbalance and location are established, an air-tool is used to drive proper size weights into predrilled holes in the flywheel or the front pulley—and the engine is in fine balance.

This electronic dynamic-balancing operation is accomplished while the engine is operating under its own power, during an already existent hot-test operation at the end of the assembly line.

General Motors Research staff also has some electronic brainchildren. A machine that's known as the Pulse Synchronized Unbalance Indicator is being installed at the end of engine production lines to take the engines' "pulse" at any running speed. Seismic magnetic pickups at each end of the engine detect unbalance. Timing or synchronized pulses from the engine ignition are used to determine the location of unbalance. Thomas Van Degrift, head of GM Research Staff's Special Problems Dept., points out that the improved quality attributed to this new balancing technique is due in part to the elimination of other rotating equipment that was required on earlier balancing machines.

These examples bear witness to the fact that electrons can help build better cars. To those who yell "tilt—these ain't automation because they aren't 'look ma no hands' operation," we say just you wait and you'll see it. The big hurdle is making the process work — improvements like automatic loading and unloading—automatic weight assembly and automatic recording and sorting—all represent known techniques and each will come with succeeding upgraded versions of the equipment.

Atoms for Peace

Progress in this business is inevitable. After all, each of the Big Three spends a potful of dough on manufacturing research. Don't fight it; if the electrons don't get you—the isotopes will.

Ford has set up extensive laboratory facilities staffed by highly trained nuclear physicists, engineering physicists and technicians.

The atom's new role in controlling quality is typified in a high-intensity beta ray gage installed in Ford's cold rolling mill. The gage automatically adjusts rollers whenever an off-standard thickness is detected.

An isotope gage also regulates the thickness of plastic coatings applied to automotive upholstery fabrics.

Inspection of castings and welds —measurement of pipe and wall thickness are other examples of Ford's day to day use of radioactive isotopes in production, maintenance and construction activities.

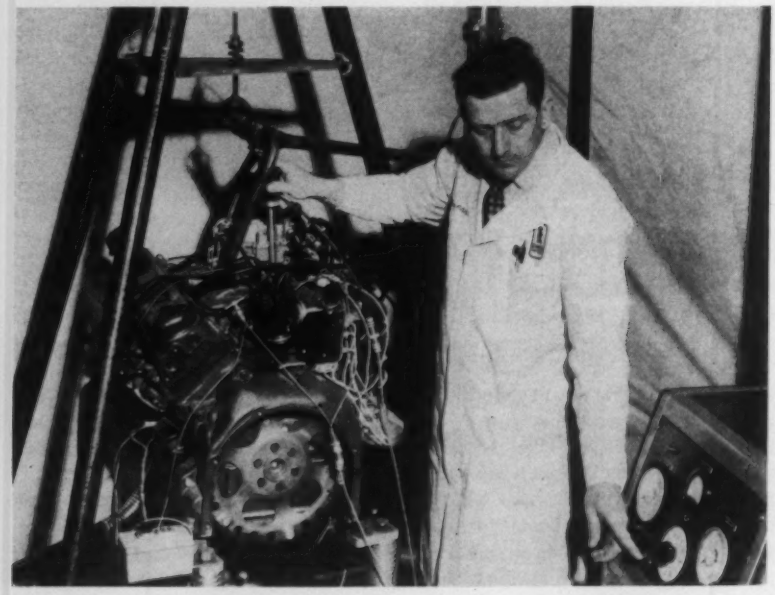
GM is putting divisional representatives through a special 10-week course to give trainees a well rounded background in radio-isotope uses so they can assist their divisions in evaluating proposed application of radioactive materials in manufacturing and processing.

The outlook for production uses of isotopes is so promising that Chrysler's James C. Zeder, vice president engineering and special advisor to the company's president, has named the shortage of nuclear scientists in this country as "today's most alarming statistic."

Wanted—Engineers

From this array of developments it would appear that when Robert Critchfield, head of GM's Process Development Staff told the American Society for Engineering Education that industrial processes have developed to the point that they require as many technically trained men as does product engineering, he wasn't just tooting his whistle.

It used to be that production men lost out in their competition for engineering graduates—the jet age and product research had too much appeal. But now with automation, electrons, and isotopes all in the picture there would seem to be ample challenge in production processes to attract many an inquisitive mind.



New electronic unit for balancing engines at the end of the assembly line has been developed by General Motors Research Staff. Known as the Pulse Synchronized Unbalance Indicator, it is now used in several GM divisions. At any running speed PSUI takes an engine's "pulse" so that unbalance can be corrected both at the flywheel (shown) or the fanbelt pulley wheel at the front end. Unbalance is corrected by putting slugs in the holes at the rims.

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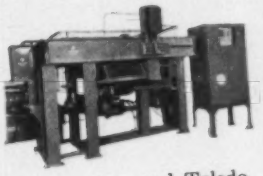

This custom-engineered Toledo automatically tests and classifies coil springs for automobiles at the rate of 900 per hour. It is one of many types of Toledos used in classifying, testing and balancing.

Automatic Bulk Weighing

Accurate, printed weight records of bulk materials such as flour going into truck or carload shipments are provided by this Toledo. Automatically weighs materials and transmits weight data to remotely located adding machine for totalizing and recording.

Electronic Weighing with Remote Dial Location

Toledos with electronic load cells eliminate mechanical connections between platform and scale head; bring new flexibility to testing and weighing operations. Dial may be located wherever desired and weight data fed into a variety of recorders and office machines for processing. Digital indication, if desired.

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This Toledo provides fast sub-surface filling of drums, eliminates frothing—cuts off flow of liquid precisely and automatically. Speeds liquid handling operation. Indicates tare, gross and net weight.

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Complete, centralized, push-button control of batching or filling operations is provided by Toledo Control Consoles such as this. Listing and adding unit receives weight data directly from remote scales.

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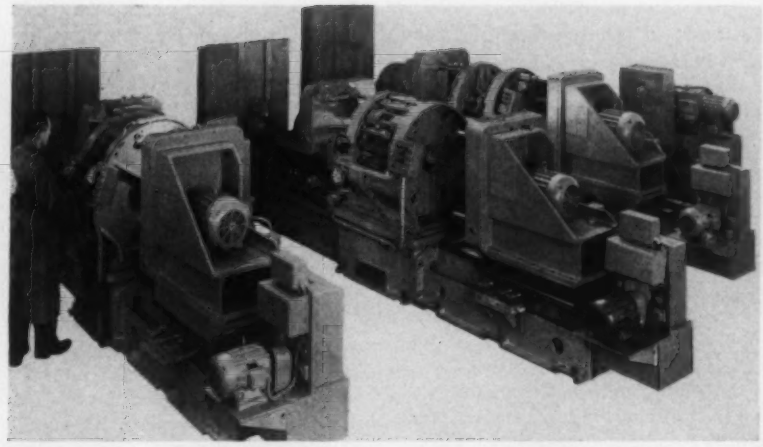
notes from britain

By FRANK G. WOOLLARD
British Correspondent



Three duplex trunnion machines and a two-way horizontal drilling machine have been built by Standard-Modern Tool Co. Ltd., Toronto, for use in Britain by an automotive manufacturer. Of similar construction, the trunnion machines are designed to machine entirely different components—main drive pinions, main shafts, and gear box covers.

Potpourri

AS HAS been commented on, automation is a much discussed subject in Britain. An insight into the importance to our country of those things affected by automation can be found in some recent remarks by the Chancellor of the Exchequer, Mr. G. E. P. Thorneycroft. At a meeting of the National Production Advisory Council on Industry, the Chancellor reviewed the prospects for a rise in output and outlined the conditions which must be fulfilled if the country is to reap the benefits of increased production.

He observed that Britain is at a turning point in economic affairs: production has been about steady for two years—with many healthy and valuable changes in its pattern but steady in total—and it now may be about to rise. However, there is the problem that the rise in production must fulfill certain conditions if risk is to be avoided and the nation benefited. One of the conditions concerns exports, another productivity.

As to exports, rising production is reflected by rising imports and to avoid a deficit abroad, a substantial share of the increase in output must go to exports. If this does not happen the government will be obliged to hold back economic expansion as it has in the last year or so. Last year about 30 per cent of the output of manufacturing industry was exported. This compares to 28 per cent in 1954 and 1955, and 29 per cent in 1953. The 30 per cent figure, or better, is the present goal. It is a good omen that in the first quarter of this year the automobile industry exported over half its output, and it is especially encouraging that exports to the U.S.A. in the first quarter are over three times bigger than in the first quarter of last year. However, the current surplus that has been built up in overseas trading must be enlarged if Britain is to play its historical role as trader, large scale investor and world banker.

This leads into the problem of productivity; over the years more has been taken out than has been put in. One solution is to take less out but a more attractive answer is to put more in.

In this regard Mr. Thorneycroft stated, "We must not have another year in which we pay ourselves more for doing the same amount of work, as we did last year and most years since the war. In many parts of industry, it should be possible to ensure that higher wage-rates are offset by higher productivity: in some, it may be practicable to do better, and bring prices down. This is an important object to aim at, for in other parts of the economy it is not always reasonable, on past experience, to expect productivity to rise as fast as wage-rates. There are bound to be some price-rises as a consequence of the present wage-round. We must try to keep them as few as possible, and offset them as far as possible elsewhere."

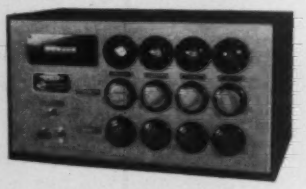
From this statement, it can be seen that increased productivity—a natural consequence of automation—is an important aspect to the well being of our national economy.

Here and There

• The Solartron Electronic Group Ltd. of Thames Ditton has developed a machine which is described as the "missing link" between the printed page containing letters and digits and the electronic computer or machine control device. The machine can "read" material and translate it into information for feeding into electronic computers. Microfilm, checks and invoices, typed documents, tally rolls and typing on punched cards can be fed into the electronic reader. The

MODEL PW-4

POST DECITRON



Preset Electronic Counter

One of a series . . . the Post PW-4, with warning signals, is an electronic counter in the 1-10,000 range.

Any desired batch count from 1-10,000 may be selected on the top row of switches and, if desired, a warning solenoid, feed gate, or similar action can be activated by setting the lower row to your "warning count".

Visual totalizer registers batch counts . . . the counter, itself, resets to zero when preset number is reached. For all electronic counting, timing, or synchronizing problems, consult POST. Write for literature.

Decitron Electronics Products Division

POST

POST MACHINERY COMPANY

Beverly, Mass.

Circle 677 on Inquiry Card

machine can read 300 characters or more per second—a double-spaced typed quarto page can be scanned in two seconds. Documents can be read while stationary or moving. The output of the reader is in the form of cards, perforated tapes, or magnetic tape that can go directly into a computer.

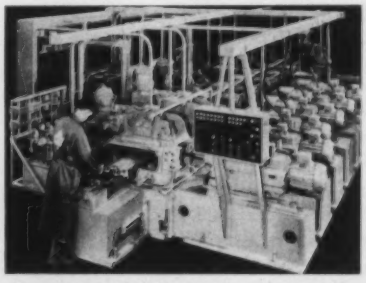
It is understood that Solartron's policy is to license suitable American manufacturers to exploit this invention in the U.S.A. Manufacturing under license is believed to be the best method of developing the machine in the North American market because adaptations can be developed and devised for its use with American electronic equipment systems by those who know these systems best.

• The research laboratories of the British post office have developed a letter-sorter which handles letters of various mixed sizes. The control mechanism is partly mechanical and partly electronic. An operator sits at one end of the machine facing a window in which each letter is shown to him in turn. He has before him a key board with twenty-four keys. In addition, there are two special keys, one for canceling wrong keying and the other for sorting letters to an unclassified selection. To sort the letter shown in the window, the operator presses two keys according to a combination which he has previously memorized. The letter is then conveyed on roller tracks by an electronically controlled memory device along rows of boxes until it reaches its proper box.

• Canadians are helping to automate Britain's automotive industry. The Standard-Modern Tool Co. Ltd., Toronto, has built two 11-station transfer machines, three duplex trunnion machines and a two-way horizontal drilling machine for special purpose application by our automotive industry.

The in-line transfer machines are designed to perform 36 drilling, reaming, milling, facing, boring, chamfering and tapping operations on automotive crankshafts. One machine produces four-cylinder shafts; the other six-cylinder shafts. Production rates for both are 48 shafts per hour at 80 per cent efficiency. Prior to the use of these in-line transfer machines the crankshafts were processed on single purpose, multi-spindle drilling machines, and on a lathe in the case of the facing operation. Accuracy in fixing the components for processing at each station is provided by hydraulic locking devices which raise the crankshafts into hardened and ground locations—registering on the two main bearings and a crankpin. Where the boring and facing operations are performed on the flange end, the crankshaft is registered on the two main bearings in carbide locations, and a hydraulically-operated collet chuck grips the small end for rotation purposes.

The three duplex trunnion-type machines are similar to each other in construction even though designed to machine entirely different components. In one, a five-station trunnion assembly provides right-and-left-hand machining of 70 main drive pinions per hour with seven drilling, facing and chamfering operations being performed. A six-station machine handles eight drilling and facing operations on main shafts at 78 components per hour. A third machine, a four-station trunnion, turns out 87 gear box rear covers per hour; the machine rough- and finish-bores, faces and chamfers both ends of the component. All of the production figures are rated at 80 per cent efficiency.



One of two 11-station transfer machines built in Canada for British automotive industry. The equipment performs 36 operations on six-cylinder automotive crankshafts. Included in the operations are keyway milling, drilling, reaming and tapping of flange holes, as well as boring and facing of the flanges. Production rate is 48 shafts per hour at 80 per cent efficiency.

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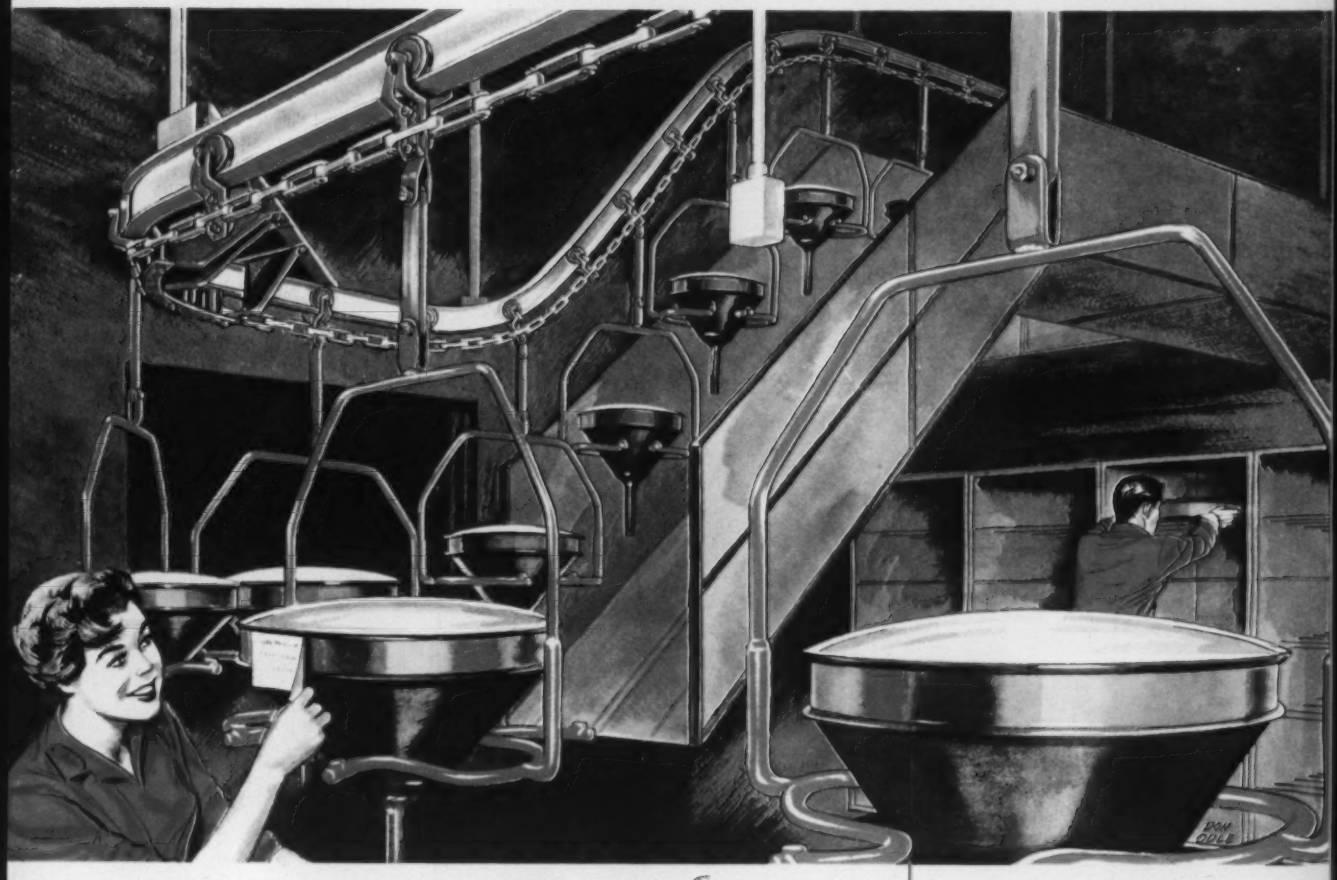
RCA SAVES 4 WAYS with WEBB Conveyors...



This Webb conveyor installation, processing RCA Colorama TV picture tubes, is a perfect example of what can be accomplished with modern conveying techniques. In addition to the obvious economies realized with mechanized materials movement, these five conveyors, totaling 2385 feet, have provided RCA with four important benefits:

1. **Save Production Time** . . . conveyors dip down at every work station to an efficient work level, bringing the material to the worker . . . minimizing manual handling.
2. **Paced Production Flow** . . . conveyors carry materials to each operation at a predetermined rate, aiding in control of production rate.
3. **Overhead Live Storage** . . . stock-piling on floors eliminated, providing greater productive area and increasing production potential of the plant.
4. **Greater Employee Safety** . . . cleaner, uncluttered work areas because materials travel and are stored overhead.

Your plant can realize these same benefits, and others as well, with modern conveyorization techniques. For more information, or for engineering service, write or call Webb today.

More Details on Reverse Side

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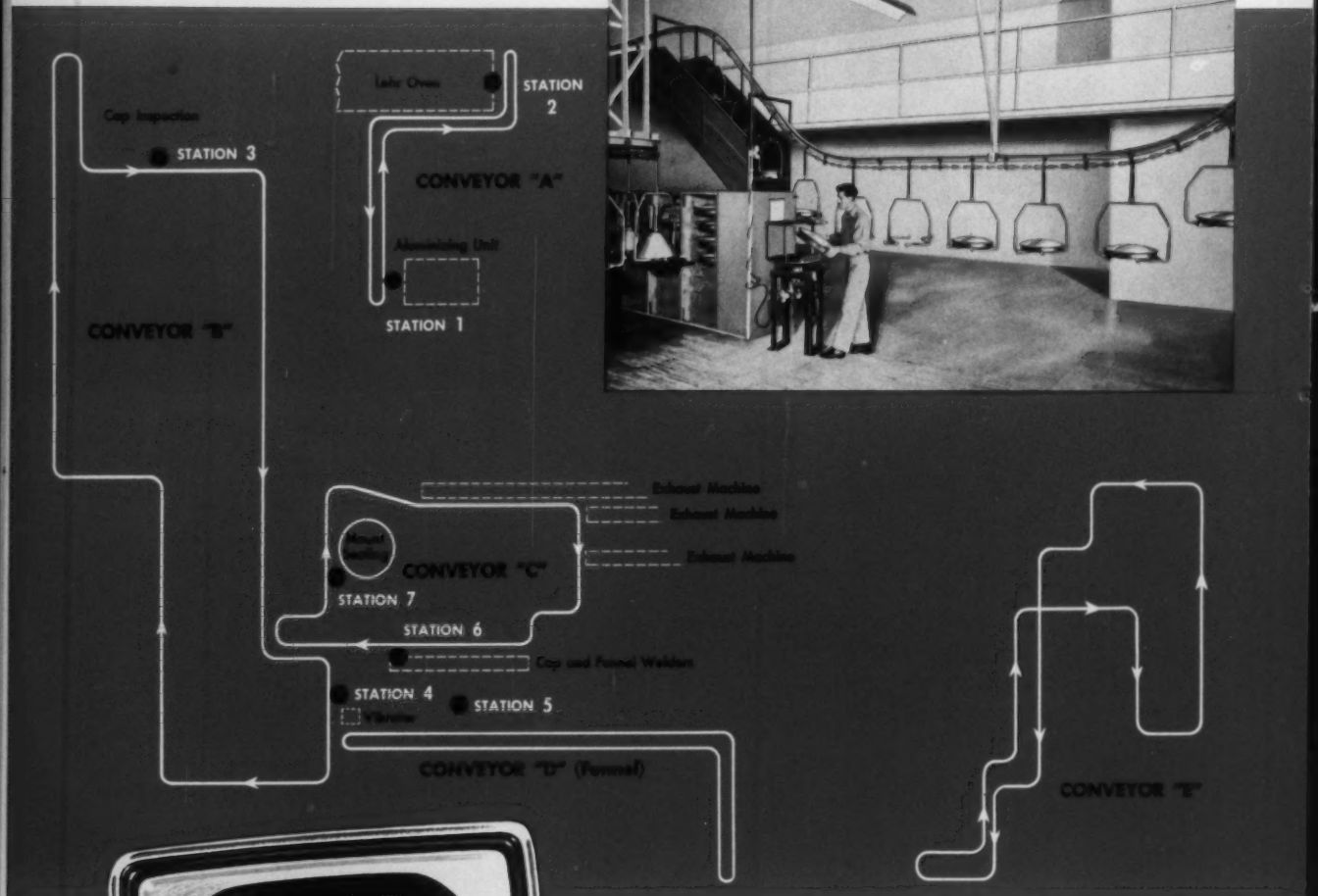
Webb Conveyors at RCA . . .



At the start of the RCA Colorama TV picture tube processing and assembly operations, the cap assemblies are taken from the aluminizing unit and placed on Webb trolley conveyor "A" at station 1. This conveyor transports the caps automatically to station 2 where they are removed and placed in a Lehr bake-out oven. After traveling through the oven, caps are inspected and placed on conveyor "B" at station 3.

The caps are then automatically carried overhead to station 4 where they are placed on a vibrator (see photo above) before being welded to funnel assemblies at station 5. Funnel assemblies are processed along the route of conveyor "D". After welding, the assemblies are placed on conveyor "C" at station 6 and carried to the mount sealing machine at station 7. This machine automatically seals the electron gun in the bulb. Several assemblies at one time rotate merry-go-round fashion in the sealing machine fixture.

Tube assemblies are again placed on conveyor "C" and conveyed to the straight line exhaust machines. Following the exhaust operation, tubes are based, aged and tested. Any tubes that fail to meet the RCA quality standards are sent to salvage on conveyor "E". The salvage conveyor carries rejects through several reclaiming operations .

Throughout the RCA plant, conveyors dip down at each work station to make materials available at a convenient height and location. Between stations, conveyors automatically carry materials overhead . . . keeping aisles clear, assuring maximum productive floor area. Each of the five conveyors carry a recirculating inventory of parts, thus keeping parts storage overhead.

The Jervis B. Webb Company manufactures all types of conveyors . . . from simple straight line units to complex systems. Webb conveyors can be designed to carry all types of materials . . . from toothpicks to logs, from raw metal to 40,000 lb. tractors. Whatever your materials, a Webb conveyor can convey them . . . at lower production cost, with greater production efficiency and with more effective production control.

If your problem is modernizing production flow . . . call a Webb Engineer

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DETROIT 4, MICHIGAN

Over and Above

When discussing automation with many businessmen, a classic comment concerns the difficulty of replacing equipment under today's depreciation tax laws. But, can you afford to slip behind and lose competitive advantage?

Perhaps a thorough re-evaluation of the whole area of capital investment is needed. Today, the trend in industry is toward brains, not brawn: toward more application of capital for increased efficiency.

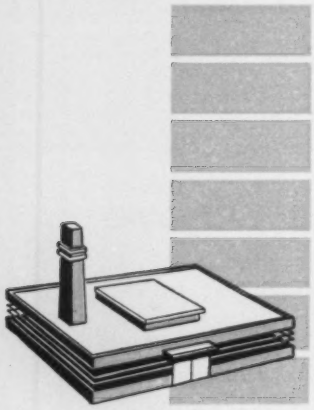
This new thinking in industry is reflected in this statement by D. D. Greenshields, president, Pittsburgh Screw and Bolt Corp., in their 1956 Annual Report:

"The high cost of replacing existing machines and equipment as they wear out or become obsolete requires an expenditure of funds substantially over and above the amount that can be provided over the years by accumulated depreciation, which must be based on original cost. The additional funds required to replace old capital assets with new must come out of retained earnings or be acquired from other sources."

Development of automated facilities, especially, cannot be considered against the backdrop of yesterday's economics. Some operations, of course, call for a complete break with present practices and require a fresh start. However, in most instances up-grading to the next higher operational level is the most practical approach.

There is a vital need in all businesses to study and evolve a planned program for continuous reinvestment of a proportion of earnings in automatic production equipment. The long-range advantages lie in automated operations.

EDITOR



AUTOMATION AFFECTS THE PLANT

Steady increase in industrial application of techniques of automation will influence the nature of the labor force and change the characteristics of the plant.

By **JOSEPH HARRINGTON, Jr.**, Head, Mechanical Engineering Section, Engineering Div., Arthur D. Little, Inc., Cambridge, Mass.

TO DISCUSS the impact of *automation* upon industrial plants, it would help to know what we mean when we use this word automation. It was invented to fill the need for a convenient verbal handle on a rather complex, intangible phenomenon. In the late 1940's and early '50's there was a pronounced and definite upturn in the Gross National Product in spite of a steady decrease in the average work week. Everyone felt that some new factor of productivity had been added, as indeed it had.

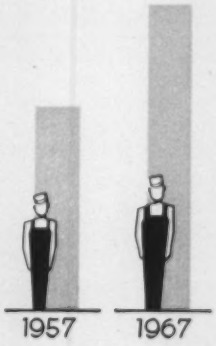
The collective effect was loosely ascribed to automation; actually, there were many factors contributing to the upswing of productivity, among them the vigorous application to industrial problems of certain scientific techniques used and developed during the war. Specifically, we can list the techniques of operations research, systems engineering, electronics, and servomechanism (or feedback) control of machines.

Indeed it is fortunate that our national productivity is increasing, for these or any other reasons, because it will be necessary to increase total production some 50 per cent in the next ten years if we are to maintain our rising standard of living with a potential increase of only 15 per cent in working force. Anything, therefore, which increases productivity must receive our most careful attention.

Automation has been carefully and officially defined by the Radio-Electronics-Television Manufacturers' Assn. as the technique of improving human productivity in the processing of materials, energy and information by utilizing in various degrees, elements of machine self-control and of automatically executed product programing. It has already had an impact on almost every facet of industrial and commercial life. For example, in light assembly work, citing my own activity, the development of the Dynasert machine manufactured by United Shoe Machinery Corp. for the assembly of electronic components into the printed wiring boards used in making radios and such equipment. A conveyor belt is arranged to carry the printed wiring board past a series of operating stations at each of which the board pauses while the mechanism inserts a component into prepared holes in the board. One or two attendants and a supervisor can operate the machine which will perform the work of twenty or thirty hand assemblers.

Information handling by machinery is exemplified in the automatic accounting system used in savings banks. When a savings teller punches into his keyboard the information as to the account number and the draft size, the machine automatically checks the balance in the account, checks for liens or stoppages against the account, makes a record of the payment, and notifies the teller that all is clear. Later, it changes the permanent record and balances the books for the day.

An example of automatic control of production can be found in the numerically controlled milling machines used in the aircraft industry for produc-



". . . it will be necessary to increase total production some 50 per cent in the next ten years if we are to maintain our rising standard of living with a potential increase of only 15 per cent in working force . . ."

This article is based on a paper presented at the National Industrial Development Exposition, May 1957.

tion of complicated aircraft parts. A designer feeds into a computer the dimensions of the part he wishes to produce and the computer reduces this design information to point-by-point location of all of the surfaces to be milled. It then computes the position of the milling machine tool and punches a paper tape telling the machine how to move the raw stock past the cutting point.

An example of materials handling by automatic equipment is the much discussed automatic warehouse. It should be possible to receive incoming shipments in bulk, distribute them into storage portions of the warehouse, and then reassemble mixed lots for local shipment, all without human handling. The automatic handling equipment can be controlled by the same punched cards which are used in inventory control, accounting, invoicing and shipping.

As an example of heavy industrial production think back to the days when steel was made in batches in an open-hearth furnace and then rolled into sheets and bar stock. Today steel making is no longer a batch process but, wherever possible, is a continuous operation.

Industrial Concept

Incidentally, note that this word automation is properly applied to something a person does—an engineer or economist—and not to a kind of machinery. Machines are properly described as *automatic;* they are becoming more automatic. But *automation* implies much, much more. It may be of interest to know how one goes about the application of this technique of automation.

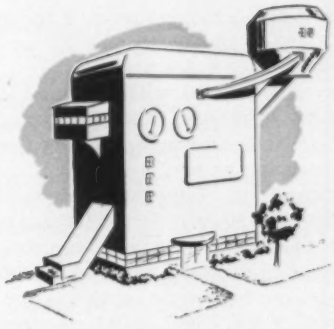
In applying this technique three steps are followed. For example:

Recently a manufacturer said to me, "I don't know what automation is, but if it's good for me, I want some." The *first* thing we have to do in such a case is to decide what the problem really is and what the manufacturer ought to try to do. These are problems in technical economics, and sometimes business management; we can use operations research to attack some of the problems. But in the end we decide what his product ought to be.

Secondly, we explore for the optimum method of achieving that product. If it is a tangible thing like an auto engine or a new plastic, we look at the process from raw material right through to the finished stock. If it is an intangible thing like information handling in banking or communication, we look at the process from input to output. We try to select the best method of achieving the goal, without regard to how it has been done in the past, but with the thought in mind of an ultimately mechanized process. This step can be described as systems engineering.

Finally, we devise the machinery to carry out the selected process. It may be mechanical, pneumatic, hydraulic, electrical or electronic equipment. This part of the task is engineering.

Such an approach can well produce significant improvements in the product as well as in the plant.



". . . carried to the fullest extent, it may produce a plant in which every bit of equipment is integrated into one big machine . . ."

But note that it is not unusual to end up with a quite different product, and quite different materials. Carried to the fullest extent, it may produce a plant in which every bit of equipment is integrated into one big machine. This doesn't happen very often, but it poses some unique problems, as shall be seen. Actually, examples of all possible degrees of mechanization can be found.

To the extent that a new plant is to approach full automation, to just that extent will the plant be affected by the following factors. Because a plant really consists of men and machinery housed in a building, let us look in detail at the way automation will affect each of these things.

Affecting the Labor Force

Will automation reduce the plant labor force? The concept of a factory populated solely by push-button controlled machines, and a general manager to push the button, is totally unrealistic and erroneous. It is responsible for some of the adverse reactions to automation, because of the implied impact on individual workers. These people are perturbed unnecessarily, and anything that can be done to dispel this misconception would be welcome.

An overall increase of 10 per cent in productivity per worker would be considered an excellent achievement. One of the most fully automatic plants anywhere in this country is the Government-owned 15mm shell plant in Rockford, Ill. It was designed for very high production and uses "20 per cent less manpower, both direct and indirect, than conventional plants."

It is not hard to see why the overall labor reduction is bound to be as small as this. If a machine is to replace a man, it must (1) Be able to do the work, and (2) do it more economically than the man. Automatic machinery is designed to do some one thing over and over, and do it well and fast. But the number of jobs in a given plant where these conditions exist is relatively small in number. There are many which call for manual skill above the ability of a financially justifiable machine, as in watch making, or which call for judgment above the ability of a reasonably

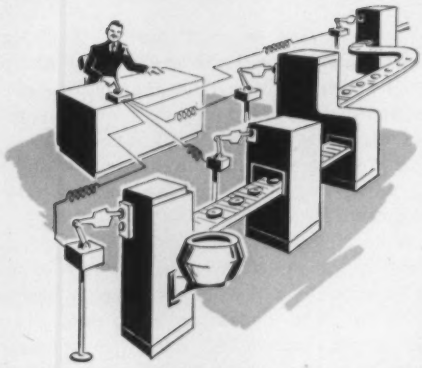
priced computer. Reductions of labor force in a small portion of the plant may be striking, but overall the average is not great.

Therefore, companies will still need to provide parking lots, cafeterias, washrooms, personnel offices, and all the other paraphernalia that go with handling working people.

Will automation change the character of the labor force? The answer to this is probably "yes." Certainly there will be a reduction in the number of unskilled laborers required per unit of production. A good example of this is the changing character of a steel mill in which years ago tremendous amounts of unskilled labor were required. Today, much of the heavy work is done by machines and fewer but more-skilled laborers are required. On the other hand, the more machinery that you can use, the more the highly skilled manual operations will be eliminated. In manufacturing watches, for example, the division of operations into simple tasks performed by machines and the introduction of a high degree of mechanization has made it possible to use machine operators with less finger dexterity and this consequently shortened training time. We can, therefore, see the emphasis changing in the kind of labor required toward the middle of the spectrum, away from unskilled labor and away from highly skilled *manual* labor.

There is one exception to this latter statement. There is at present a dearth of highly skilled electronic technicians, instrumentation men, mechanics, and hydraulic or pneumatic technicians. Such people are urgently required to keep intricate machinery in operation and will come to form the backbone of highly mechanized factories.

It appears, therefore, that automation will involve seeking access to a different kind of labor than in the past.



". . . the concept of a factory populated solely by pushbutton controlled machines, and a general manager to push the button, is totally unrealistic and erroneous . . ."

Will automation change the nature of plant management? If the productivity of the individual worker is to be increased, this leads to the conclusion that there will be a higher ratio of management people to productive workers in the factory. As yet the automatic machines are not self-managing. By the same token, there will be a higher ratio of maintenance people to productive people. As an example, when a machine was installed to assemble electronic equipment, the personnel complement included one foreman, four stock girls, an inspector, and four maintenance people to keep the machine adjusted and running. Previously this same production had required a foreman, two supervisors, four stock girls, one maintenance man, thirteen inspectors, and one hundred assemblers.

It is well to point out here also that the concept of maintenance of highly mechanized equipment is different from the accepted accounting classification of maintenance. These skilled technicians are essential to keep the machines adjusted and operating correctly and actually form a part of the production team.

If, as previously suggested, automation in a plant is carried to the point where all of the equipment forms a single, integrated machine, then it is bound to cross over old lines of supervisory control and thus it will change the plant organization structure. Where previously there were two or three departments, each with a foreman, now there is but one, because control of one machine line cannot very well be divided among several foremen.

Similarly, where previously there may have been several craft or skill unions and possibly a maintenance union, the machine now crosses these jurisdictional lines.

How does Labor react to this potential change? Fortunately, the informed leaders of American labor are very receptive to the contribution which mechanization can make to the American economy and have not raised opposition, in general, to the introduction of automation. They are, of course, concerned with the interests of the individual workers and naturally endeavor to protect these work-

THE AUTHOR

JOSEPH HARRINGTON, Jr. is head of the Mechanical Engineering Section of the Engineering Div. of Arthur D. Little, Inc., industrial research company of Cambridge, Mass. As such, he is concerned with the solution of problems involving mechanisms, materials, machines, methods and manufacturing. This work includes analytical mechanics, systems engineering and automation equipment.

Dr. Harrington was assistant director of research at United Shoe Machinery Corp. for many years, where he was in charge of research programing and diversification activities. His experience includes the design of automatic assembly equipment for electronics.

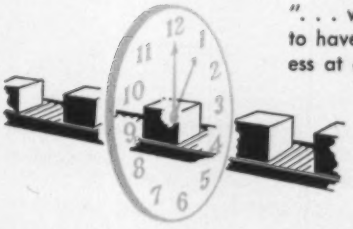
He received his Sc.D. degree from Massachusetts Institute of Technology in mechanical engineering. He is a registered professional engineer and is chairman of the Automation Equipment and Computer Panel of the Radio-Electronics-Television Manufacturers' Association.

ers from technological displacement, even though unemployment is only temporary. Recently we have noted the beginning of a long-term drive on the part of labor to achieve a work week even shorter than forty hours to take advantage of the increasing productivity which automation is expected to bring.

Let us now turn from the people to the machinery and buildings.

Affecting the Physical Plant

Will plant sizes be changed? Some reduction in size can be expected. As pointed out before, a 10 per cent reduction in working force would be quite an achievement—a corresponding reduction in plant area might be expected. We can also expect to have less work-in-process at any given time because mechanized production lines keep the work moving at all times. Also, because automation implies programing and rapid manufacture, smaller finished stock inventories can be expected. I know of one plant which expects to reduce its finished stock by 50 per cent,



". . . we can also expect to have less work-in-process at a given time . . ."

substituting for its present large inventory a rapid planned production-to-order, and a smaller stock and shipping room.

The cost of automatic equipment is so great that it is wise to keep it operating as many hours per day as possible, which suggests two- or three-shift activity. If on these expensive automatic machines a small operating crew is required, it should be less difficult to staff the second and third shifts than if the equivalent amount of unskilled or semi-skilled labor had to be brought in at night.

On balance, therefore, we can expect somewhat smaller plants, in proportion to the degrees of mechanization achieved.

Will automation change the layout or character of a plant? In general, it is a principle of mechanization to convey work mechanically from place to place, taking it from one machine and feeding it to the next without losing orientation or control. If then, all material handling is accomplished by conveyors, there is less objection to multistory plants than when materials were carried by hand, truck, or similar methods.

We can, of course, expect improved safety and a general upgrading in the working conditions as a result of automation. This is not only inherent in the more mechanized processes, but is a demand of the class of people who work on this equipment.

Will automation indicate change in plant locations? There are many factors influencing plant location which are only secondarily touched by the considerations of automation, but remember specifically the access to a different kind of labor market, as noted previously. It is also wise to be close to the source of spare parts and service facilities for your production machinery if you do not intend to provide a self-sufficient maintenance and repair shop.

Will automation change plant costs? Referring only to the capital equipment installed in the plants, a sizable investment in the specialized machinery implied by automation can be expected. As yet, almost all such equipment is custom built and is, therefore, made in small lots and is expensive. It is almost all built by specialists and the development costs are inevitably high. The occasions in which there has been a reduction in capital equipment costs have been those chemical plants in which large process storage tanks have been eliminated completely when a change from batch processing to continuous processing has completely eliminated some steps in the process.

Pace of Progress

Before leaving this subject, a word should be said on how imminent these changes are. Automation is not about to revolutionize American industry. As mentioned previously, there has been a distinct upturn in the rate of productivity in the recent years, but there are built-in limiting factors which prevent this new technique's changing from a gradual growth into a stampede.

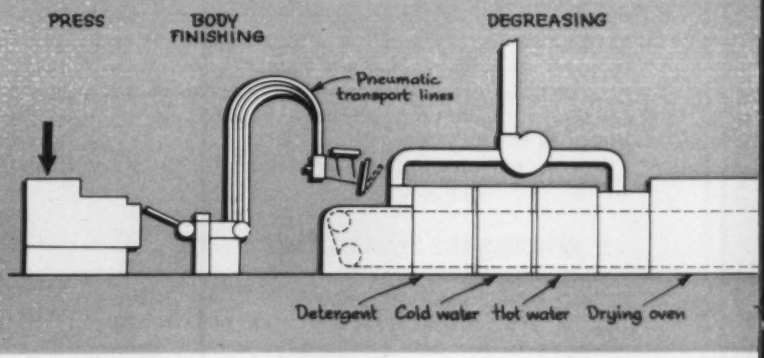
The first of these is the initial investment in equipment. Few people are willing to undertake an investment which will not pay for itself in one to three years on the basis of the money savings which can be credited to mechanization. The savings, however, do require the initial expenditure of a sizable amount of money.

Secondly, there is a lack of really competent engineering talent to design and install this equipment. A wise management will not undertake a development without carrying out the steps of determining what they ought to do (which requires economic analysis), of determining how best to do it (which requires systems engineering and good technology) before acquiring new plant equipment (which involves engineering). It is axiomatic that a team of economists, technologists, and engineers is required. Most industrial organizations find it difficult to assemble such a team within their own plant.

The third reason is management's lack of courage required to embark on such a major project. The decision to automate involves not only the manufacturing areas, but sales, product policy, and finance. It is not a program to be undertaken lightly and many an organization has hesitated before embarking on such a career.

Therefore, automation will not sweep the country—fortunately—but will come along steadily and at a steadily increasing rate.

1



Flow sketch of process for making seamless, rigid aluminum cans. Pilot plant is in operation at Aluminiumwerke Goettingen G.m.b.H. factory at Goettingen, Germany. Can bodies are made in a horizontal, impact extrusion press. Body finishing unit trims cans to length, forms flanges or beads, or modifies contour of can bottom depending on end-use of cans. Degreasing section removes process oil. Internal lacquering section coats inside of cans, and decorating equipment prints labels directly on cans.

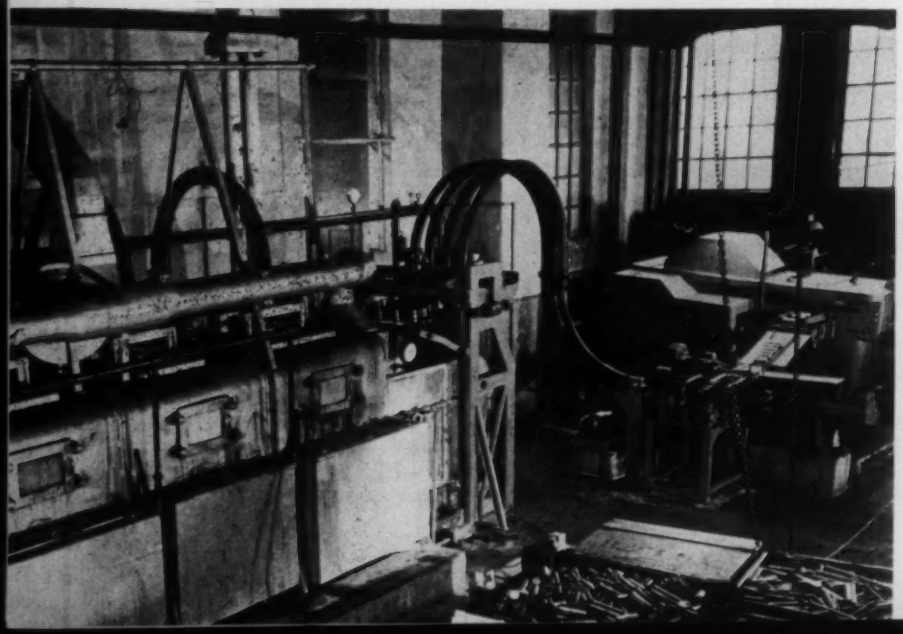
AUTOMATION TODAY

MAKING ALUMINUM CANS

RESEARCH into new and improved manufacturing processes is a subject of vital interest to those responsible for increased use of automation. Such research is also of importance to suppliers of basic materials. New fabricating techniques can open up new markets for materials. A material not generally specified for a particular product can become highly desirable if new production methods are developed to make that product.

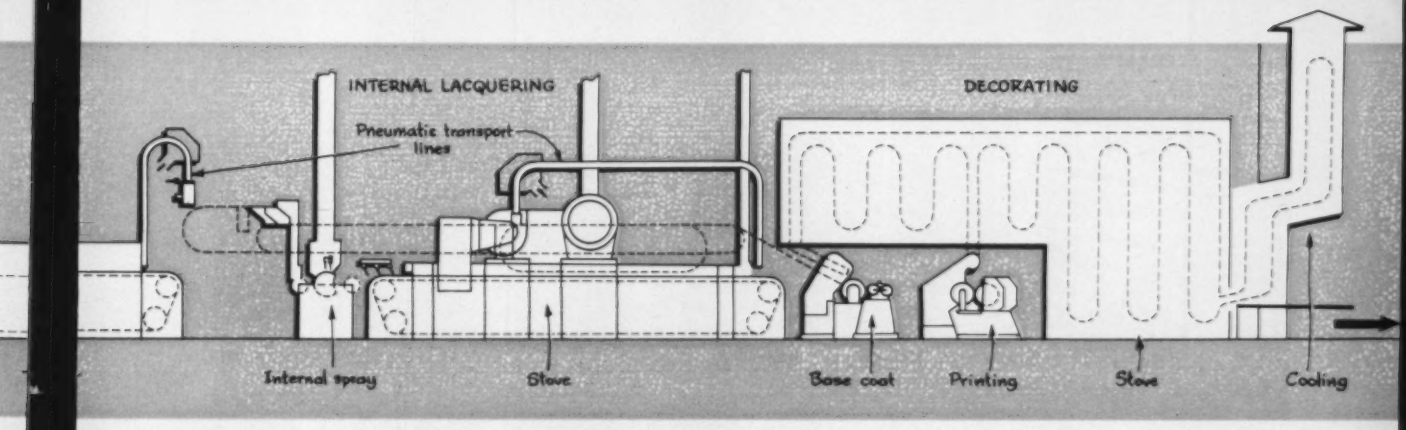
A case in point is the development of an automated production line for the manufacture of seamless, rigid aluminum cans. This manufacturing research project was undertaken by Aluminium Ltd. of Canada, whose production is heavily concentrated on ingots to supply independent fabricators.

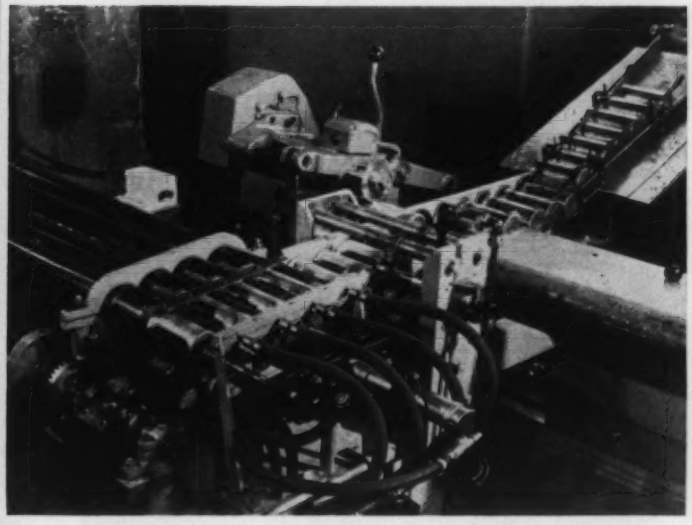
In speaking of this project at the announcement of the successful operation of the pilot plant, E. G. MacDowell, a director of Aluminium Ltd. said: ". . . it is our responsibility to undertake this broad program to foster the use of aluminum. You can well imagine that research and development of this kind takes a great deal of money, patience,



2

Slugs of aluminum are fed to the die in the 320-ton Herlan press shown at right. As a sharp blow is struck, malleable aluminum squirts over the punch to form a seamless can body. Press shown will produce a can up to 2¾-inches in diameter by 6 inches high. Body finishing unit is shown in front of press. Pneumatic tubes lead from body finisher to degreasing section.





3

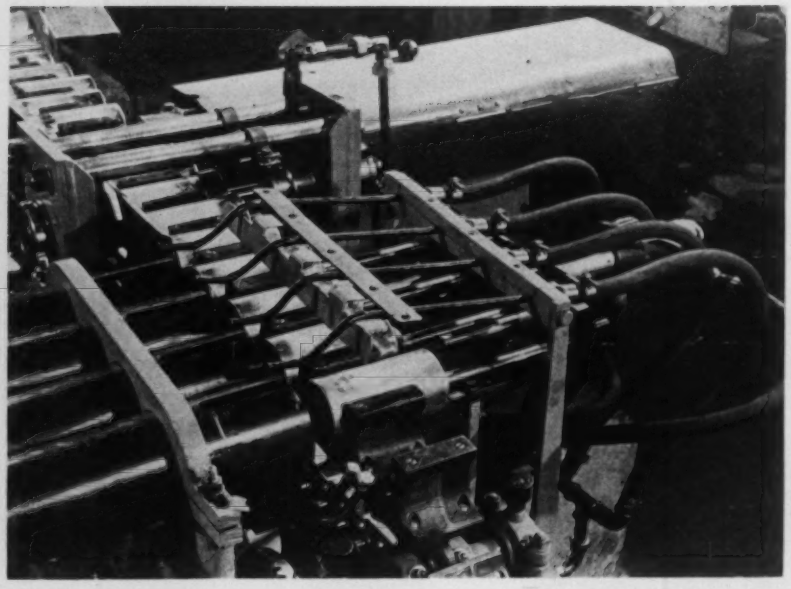
Special chain conveyor has pairs of machined blocks of cloth-laminated Bakelite resin. As chain passes over sprocket near the press, blocks open to receive a can from the chute. Intermittent motion of chain, synchronized with output speed of press, carries each can in turn to three stations of finishing unit. Base is formed. Body is trimmed to length and flanged. All or some operations can be selected according to type of can in production.

and energy and is well beyond the scope of most of our customers. It is my opinion that the development of the 'Automatic AC Line' will prove to be of great significance to the packaging industry in the United States and elsewhere because it points to reduced costs in can making and to increased use of aluminum cans for packaging a wide variety of products."

The company's pioneering work in this area of manufacturing research was begun in the 1930's with the Norwegian fishing industry and involved aluminum sardine cans. Their research subsidiary, Aluminium Laboratories, found that the known tin plate handling methods and equipment have, almost without exception, proved unsuitable to handle and process aluminum containers. Therefore, a completely fresh approach was decided upon which would eliminate the troubles that arise in using modified tin plate machinery.

The early stages of the development work were directed to the establishment of basic principles for the individual operations in can manufacture, including pressing, continuous degreasing, internal lacquering and high speed stoving. A prototype continuous degreasing machine and a continuous stoving oven were designed, built and tested under laboratory conditions and found to operate satisfactorily. At the same time, work was also being carried out on methods of handling aluminum cans automatically, and a pneumatic carrier system was evolved which showed promise of being able to handle cans of varying sizes at high speed. Several problems had to be overcome, as the usual methods of handling tin plate cans are unsuitable for aluminum because of the lighter weight and high surface friction of the degreased aluminum can. The system as finally designed employs pneumatic tubes between units through which the cans are either blown with compressed air or sucked by a partial vacuum induced in the tubes. Such a system will handle a wide variation in can sizes without major adjustments to the equipment.

After the individual units and transfer mechanisms had been proved on a laboratory basis, the second stage of the development was the design and construction of a prototype automatic line to investigate the behavior of the individual units and transfer mechanisms when operated on a pro-



4

After chain leaves last station of finishing unit it passes over a curved frame that causes block clamps to open slightly. As four cans come into position in front of four polyvinyl chloride plastic tubes, push rods inject cans 6 inches into tubes and four air jets send batch of cans to degreaser.

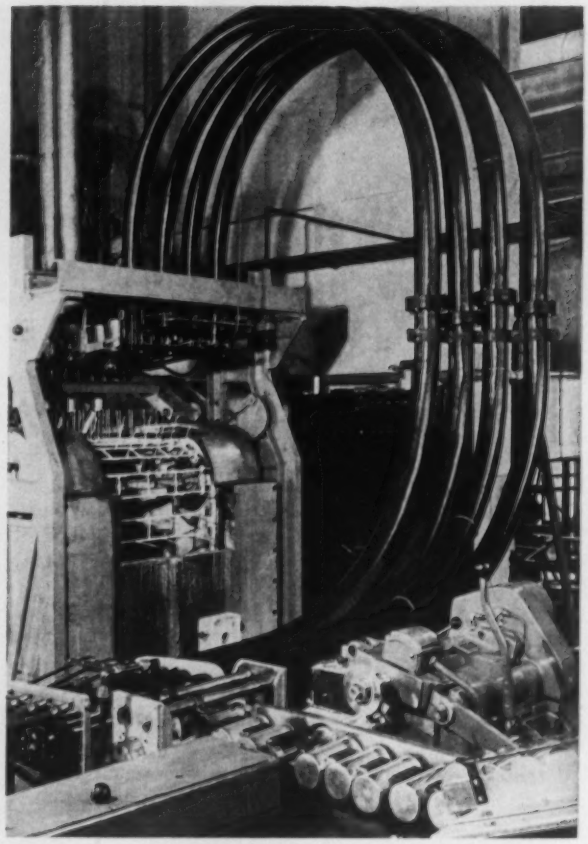
duction scale. This stage has now been reached at the factory of another of Aluminum's subsidiaries —Aluminiumwerke Goettingen G.m.b.H., Goettingen, Germany. The line was developed by Aluminium engineers in Canada, at Banbury, England, and in Germany. Its special automatic feed equipment was perfected by Winkler Fallert, of Berne, Switzerland, press manufacturers.

The prototype line consists of five main groups of equipment: (1) Impact extrusion press, for making the can body, (2) body finishing group, for trimming, bead or flange forming, and modifying the bottom of the can; (3) continuous degreasing machine, to remove process oils, (4) internal lacquering machine, for protective coating inside of can, (5) decorating group, for base coating and label printing outside of can. These groups are linked together by automatic handling devices.

This equipment will handle cans from 2 to 3 inches in diameter and from 2 to 6 inches in height. Change-over from one size to another involves changing tooling on the machines and making minor adjustments to handling devices. Under normal conditions three men complete a change-over in about two hours.

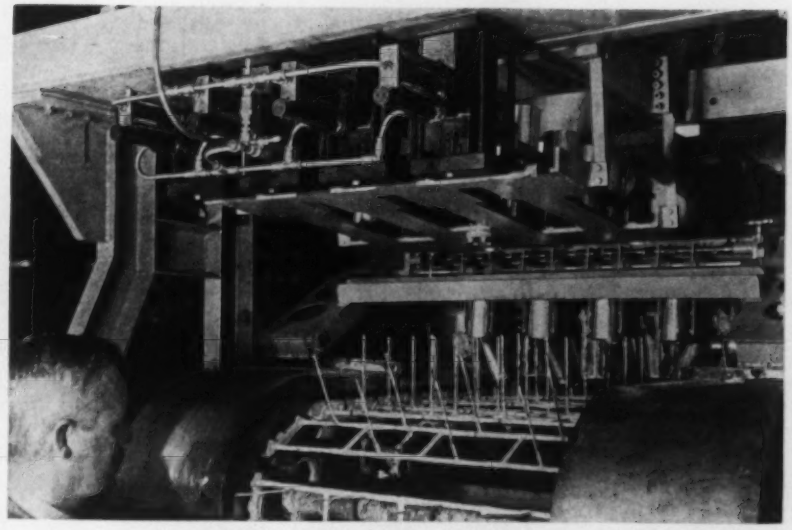
The accompanying photos show the principal steps in the process and details of the unique equipment used to transfer cans from one operation to the next.

Those involved in this manufacturing research project visualize even greater strides toward integrated production, and predict that eventually there could be added to this process a continuous casting unit, in which primary ingot would be melted, and converted into a continuous strip of aluminum. From this strip slugs would be punched out, and fed continuously into the press. Such thinking is fundamental to greater advancements in the field of automation.



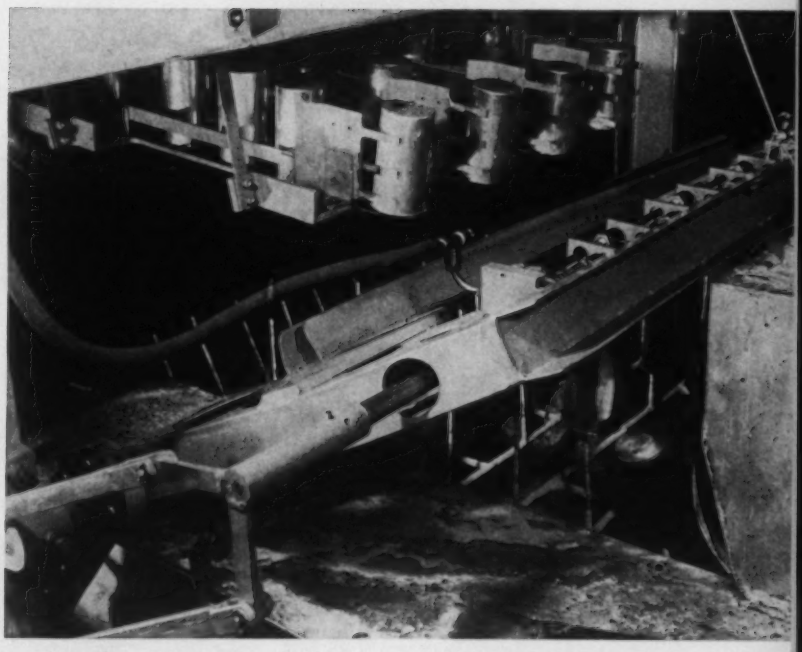
5

Plastic tubes convey cans from body finishing unit to degreasing section. Ports located just ahead of delivery ends of tubes release air in advance of cans. After cans pass ports, air cushions are formed against sealed delivery ends of blow tubes. Air cushions bring cans to rest gently.



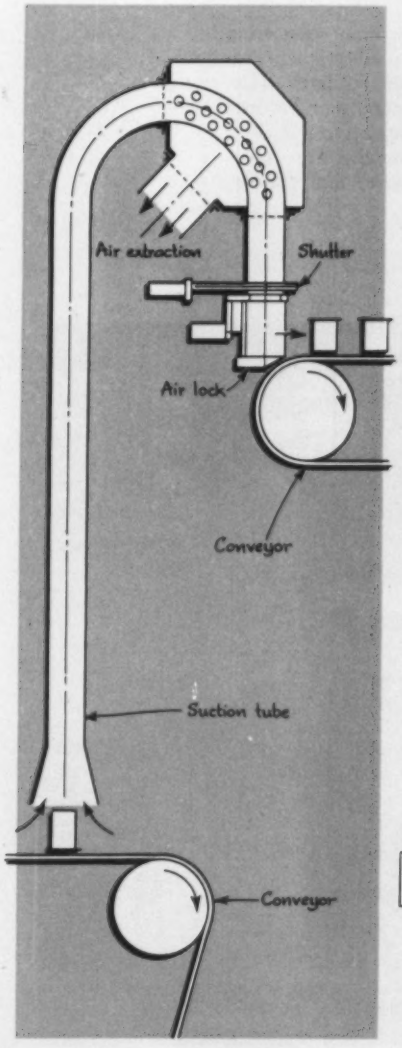
6

After cans have come to rest, twin doors in an air lock open. Push rods which are operated by air cylinders eject cans onto an inclined oscillating table. Operation of this ejection equipment is synchronized with air jets on entry ends of tubes. Although only one can at a time is passing through each tube, system will handle 30 cans per minute per tube.



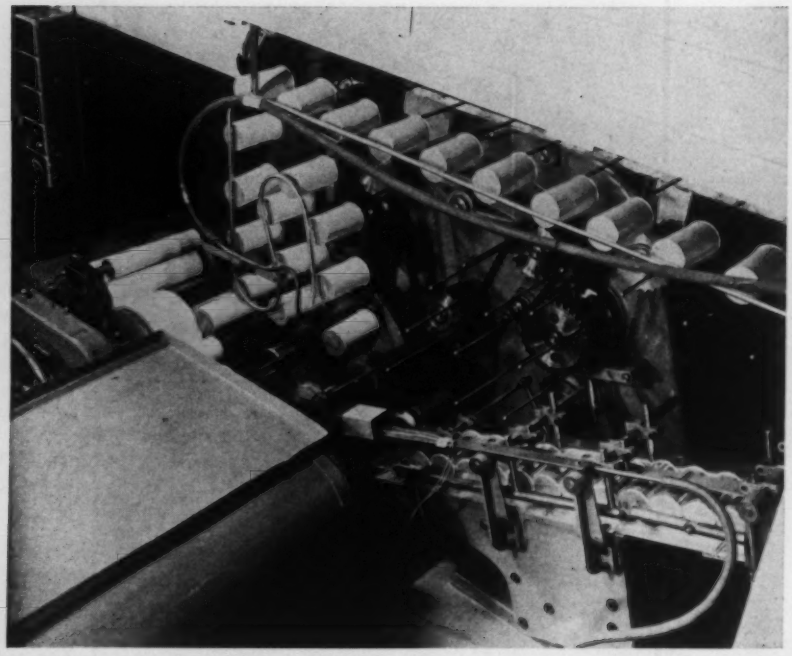
7

Four rows of cans move to end of inclined oscillating table. Spring fingers prevent cans from falling out. Air cylinder-operated gripper arms mounted on oscillating frame pick four cans from table and place them on pegs of degreasing machine conveyor. Motions of grippers and frame are synchronized with movement of conveyor. In the degreasing machine hot alkaline detergent is sprayed on all surfaces of the can. This is followed by two rinses, first cold then hot. Cans are dried by hot air.

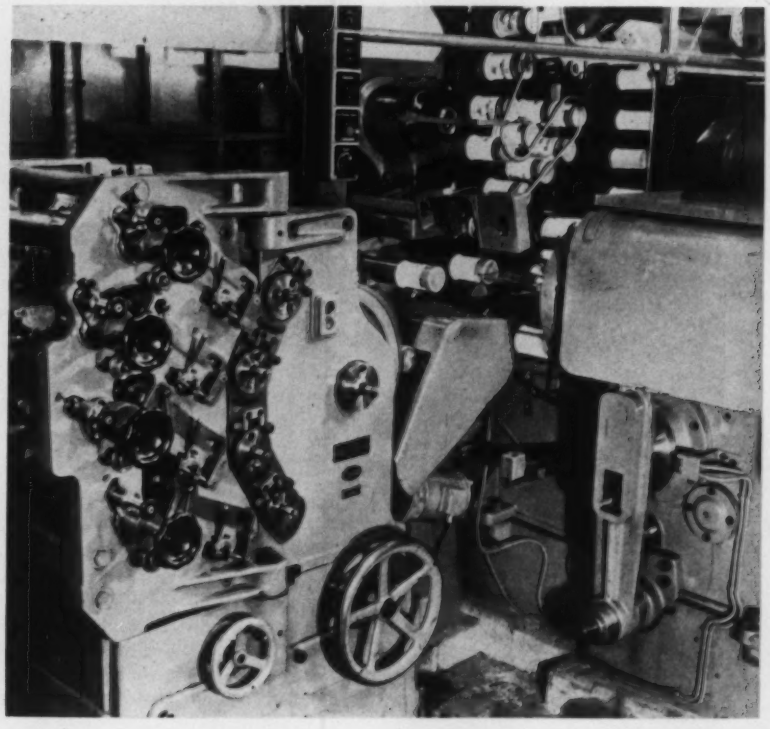


8

Emerging from drying zone of degreasing machine, cans pass beneath four tubes in which a vacuum is induced by suction chest surrounding all four tubes. Air lock mechanisms include shutters to seal tubes and allow cans to be ejected without interrupting partial vacuum. Unit transfers cans from one conveyor to another and inverts them in the process. Cans pass along stainless steel conveyor in four rows and either enter conveyor of spray laquering machine or are directed onto bypass conveyor, according to type of can.



9 Feed chute (lower right) at base-coating machine is supplied from internal lacquering unit's cooling conveyor and from bypass conveyor. Base-coating and printing machines are synchronized with automatic feed and take-off mechanisms. Each cycle, four sets of gripper arms remove cans from incoming chute and coating mandrel and load cans on outgoing conveyor and next coating mandrel. Outgoing conveyor is a chain with protruding horizontal pegs. This chain passes continuously from base-coating machine, into stove, out to printing machine, back into stove, thru cooling, and returns empty to base-coating machine.



10 Plain base-coated cans arrive at second stage of printing operation where decoration is automatically applied. Base coat has been partially dried. Printed cans go to stove for combined drying of printing ink and final drying of base coat. Cans then go on to packing equipment.

Hydraulic Control of Automatic Machinery

SYNTHESIS OF SYSTEMS . . . 1

FIRST CONSIDERATIONS FOR HYDRAULIC CONTROL

This introduction to hydraulic control of automatic machines by a leading British authority on the subject is the first of an exclusive series to be presented to the readers of AUTOMATION. The special approach taken here will be the synthesis of systems from commercially available components.

By R. HADEKEL, Engineering Supt. (Hydraulics), Sperry Gyroscope Co., Ltd., Brentford, England

MANY TEXTBOOKS and countless technical articles and papers are now available to guide the engineer in the general problems involved in the design of hydraulically operated machinery and accessories. This series of articles approaches these problems from a special angle; namely, the synthesis of systems from commercially available components. The emphasis will be on systems, and components will be viewed not from the aspect of their design problems, but only as a means to an end. Some understanding of component design is of course necessary for evaluating the relative merits of competitive commercial units, and this will be brought out wherever it is relevant to the main theme.

As a first step, it is desirable to establish the realm of applicability of hydraulics in the design of modern automatic machinery. The choice between hydraulic and other means of actuation and control unfortunately is not always clear-cut. For practical purposes however, it will be sufficient to compare hydraulic with electro-mechanical methods, these two being the alternatives in the majority of cases.

First and foremost, hydraulics is a particularly convenient method of exerting large loads, especially if these loads have to be held for any period of time. Chiefly for this reason, hydraulic operation is often an automatic choice for press brakes, *Fig.* 1, forming presses, and for a number of allied machines such as broaching, diecasting, and injecting molding machines.

Secondly, the installation problems of a hydraulic cylinder and associated piping may often be easier than those for an electric motor with attendant reduction gearing, or for transmission of mechanical power over long spans.

As an economic and efficient means of providing selection of a fixed number of speeds, mechanical gearboxes are still unbeatable for most applications. Where the speed must be changed in motion however, as in many machine tool operating cycles, *Figs.* 2 and 3, hydraulic control is particularly convenient.

For continuous speed control, including most forms of servo control, hydraulic actuation is highly convenient and reasonably cheap provided high energy conversion efficiency is not aimed at; that

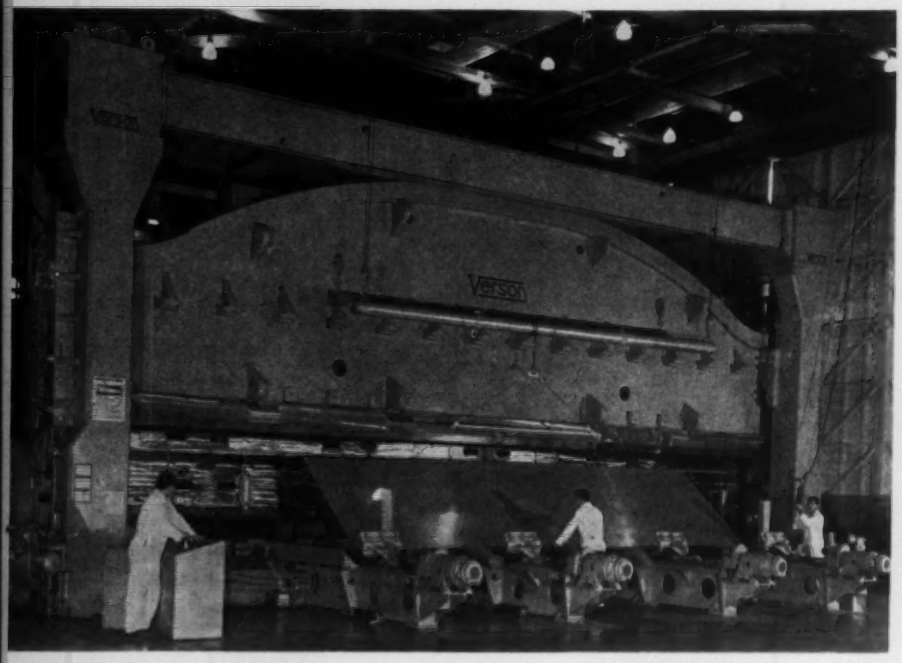


Fig. 1—Giant 1800-ton Verson Allsteel Press Co. press brake illustrates the heavy force-exerting capabilities of hydraulics. One cylinder at each end of the press actuates the ram through independent, matched pumps driven by a single electric motor. Plates up to 10 by 40 feet in size can be formed.

is, provided valve control may be used. Thus, hydraulics is a standard form of control for copying lathes. Where high energy conversion efficiency is required, as for tape-controlled milling machines, both hydraulic and electrical servos are presently in use. In the hydraulic versions, variable delivery pumps must be used which are relatively expensive. However, they are not necessarily more costly than their electrical analogues, which include Ward-Leonard and Amplidyne drives, especially if the output motion is to be linear. Usually, too, the acceleration characteristics are better for hydraulic than for electrical drives because of the much smaller inertia of systems composed of hydraulic components. This factor is of great significance in high-performance servomechanisms.

In general, therefore, hydraulic equipment is best applied when performing the functions of "muscle"; that is, in the actuating portions of machinery, which include actuators proper and the immediate controls therefor. Compared with electrical apparatus, hydraulics is less effective when it comes to the functions of signaling and computing, both of which are almost inevitably involved to some extent in servomechanisms and other automatic controls for machinery. Where these functions become complex, an appropriate division of labor between electrical and hydraulic components often leads to the optimum solution. Cases also arise where it is desirable to mix hydraulic and pneumatic actuation. Thus in an automatic manufacturing cycle, clamping may be effected pneumatically and feed control hydraulically; again, pneumatic pilot control of main valves is quite feasible as an alternative to hydraulic pilot control, and many commercial hydraulic valves are suitable for either type of control. Worthwhile economies may often be effected by such mixing, and the alert designer will always consider the advantages.

▶ Some Guiding Principles

Having broadly defined the field of applicability of hydraulics, it remains to translate this information into a basis for the intelligent selection of system components. Unless the problem be very unusual, the range of components offered nowadays will usually be found adequate to enable quite effective systems to be built up. As a start, some general principles will be laid down which influence the choice of particular components.

In the last analysis, all criteria of production machine design may be said to be economic ones. Taking a very elementary view of the matter, economic considerations may be reduced to the initial cost of the machine and its operating cost. In practice, the majority of machines which call for really original design have no strictly established standard of price, and the customer is more likely to be interested in operating costs and effectiveness than in small savings in purchase price, within reason of course. In this connection, it is well to remember that quite significant price differentials in hydraulic equipment may not add any substantial percentage to the cost of the machine as a whole. On this basis, it is seldom worthwhile trying to simplify systems for the sake of economy only, at some cost in effectiveness. An example of such a procedure would be the specifying of plain needle valves for the adjustment of flow, instead of more expensive metering valves which have the advantage of being insensitive to load.

An even more important consideration is the reliability and durability of the equipment that

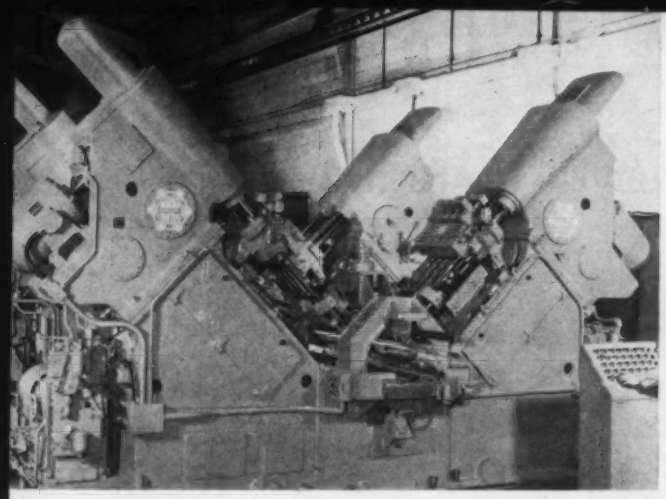


Fig. 2—Hydraulic reciprocation of heads is a feature of this 16-spindle Micromatic honing machine which automatically hones cylinder bores in automotive V-8 engine blocks.

is selected. These features have an obvious bearing on operating costs, and should come high on the list of criteria of comparison when a choice is to be made between competitive items which otherwise have broadly similar functional characteristics. The assessment of reliability and durability is not always possible when based on catalog information alone, and for this reason the wily engineer will also try to get the benefit of such experience as may have been acquired by others in using the products under consideration. However, many manufacturers do give fairly comprehensive details as to the construction of their products, including mention of the materials used, which may be helpful in forming an opinion.

▶ Uses and Misuses of Data

Catalogs are often one of the most fascinating forms of technical literature, but there is some art in using them to best advantage. The first principle of course is to acquire as many as you can. Many claims for special features or advantages may be found to be almost exactly duplicated by several manufacturers, and in fact the special features may turn out to be no more than ordinary good standard practice. Unorthodox constructions, particularly in valves, are perhaps devised more often for the sake of lowering the cost of manufacture than because they show any advantage in performance. Any such items should be examined very critically from the point of view of durability.

A number of catalogs give technical hints which, particularly when coming from some of the larger old-established firms, are usually sound and may be very helpful. Rules of thumb, particularly those relating to permissible velocities in pipes, should however be treated with some reserve. The proper way to deal with pipe losses is to calculate them according to the well-established principles of hydrodynamics, which have been known for many years and are available in any good textbook. Why they are not more widely used is a mystery to the author. Some catalogs do go so far as to give proper charts for determining pipe losses. In many cases however these charts are drawn up for one particular viscosity only; namely, that of the oil recommended by the particular manufacturer for his products, and they must not, of course, be used directly for calculating losses with oils of different viscosities.

Second part of this series, to cover selection and evaluation of pumps and actuators, will appear in the October issue.

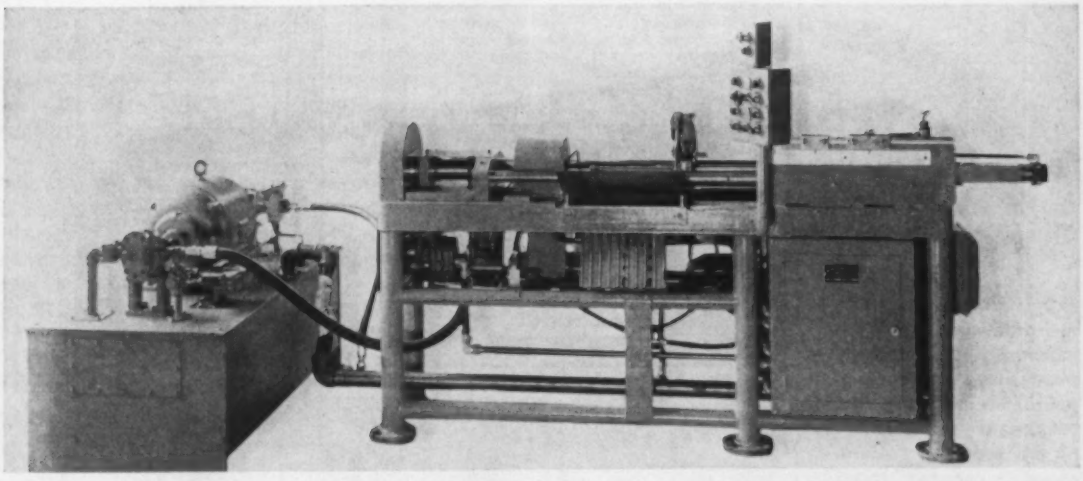


Fig. 3—Morley Machinery Corp. tube knurling machine employs hydraulics to rotate headstock at two speeds and feed carriage at three speeds forward and one reverse. Accessories such as tube clamps, loading slide and die head are also actuated hydraulically. Note separate pressure generating unit at left.

PROPER PLANNING PAYS IN

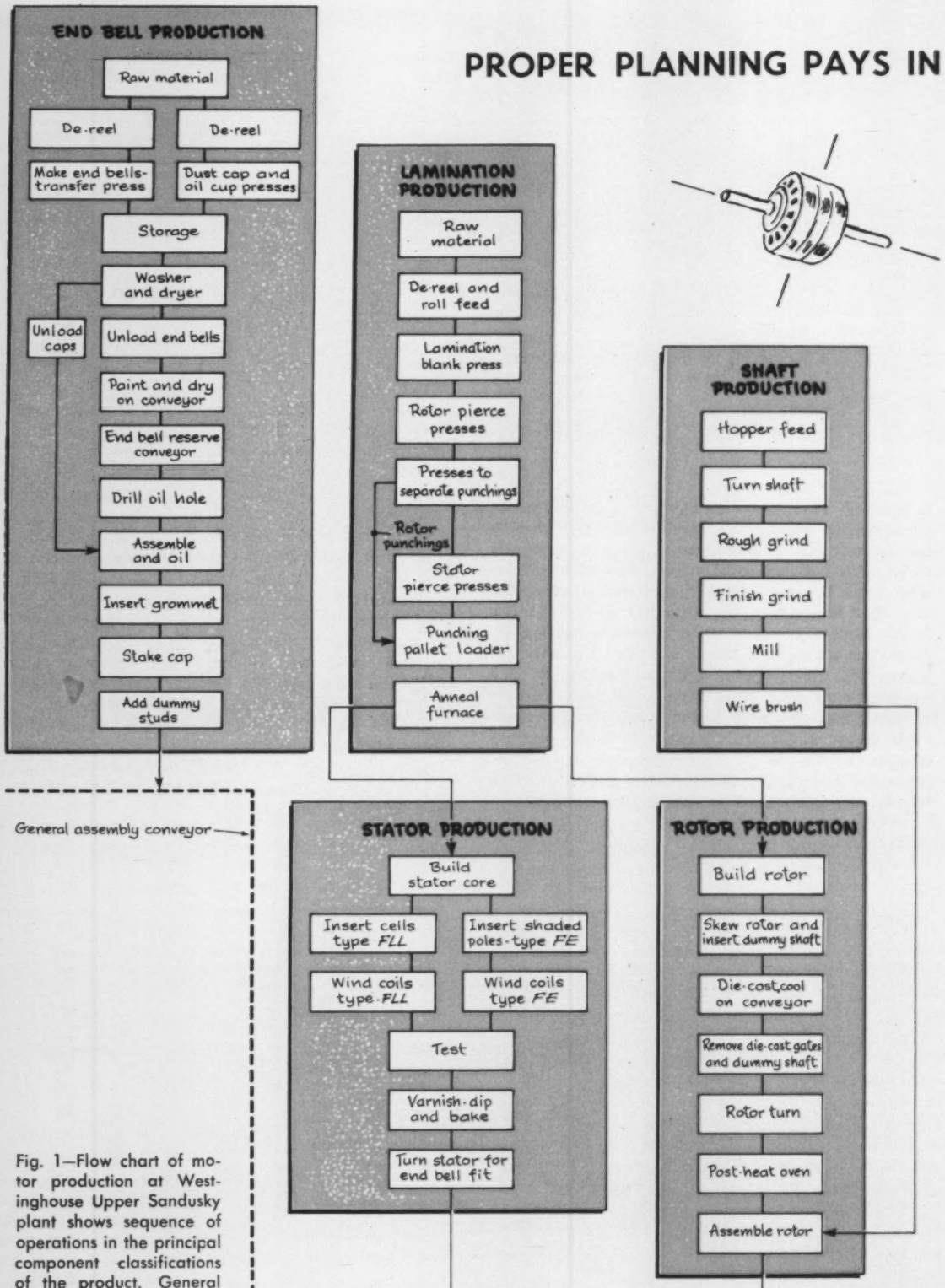


Fig. 1—Flow chart of motor production at Westinghouse Upper Sandusky plant shows sequence of operations in the principal component classifications of the product. General assembly conveyor passes end of each component line and takes completed parts to general assembly line.

AUTOMATED MOTOR PLANT

Here is the automation engineers' ideal. To meet skyrocketing product demand revealed by market surveys, a new production facility was created to make motors for air-conditioner fans on an automated basis.

A MOST HIGHLY automated small motor plant was recently put into production by Westinghouse Electric Corp. The plant, located at Upper Sandusky, Ohio, is the newest of four fractional horsepower motor plants operated by the company's small motor division. The one-story 66,000-square foot plant, although highly automated, is flexible enough to permit manufacture of two basically different fractional horsepower motors, in about 30 different styles and sizes of shaded-pole and permanent-split capacitor types.

These shaded-pole and permanent-split capacitor motors are used for direct-connected fan applications, such as room air conditioners, unit heaters and coolers, furnace blowers, and window fans.

About five years ago, after conducting an extensive survey of the skyrocketing motor requirements of the fan and air-conditioning industry, the company decided to enter the market. Manufacturing facilities available in the small motor division's existing plants were not suitable for supplying the needs of a significant part of this industry. Motors for the fan and air-conditioning industry are not only required in a size none of the plants was set up to produce, but also they are different in design and construction.

"We were faced then with two major problems," says Frank E. Heikkila, manager of the division's industrial motor department. "To design a complete line of motors to serve this important industry; and to design, layout, and build a plant to produce the motors as efficiently as possible while maintaining the high standards of quality associated with Westinghouse equipment.

"Since we were starting from scratch, with neither motor design nor plant, we were able to closely co-ordinate motor and plant design to take full advantage of the most up-to-date manufacturing processes and techniques."

Motor Design

Throughout the surveys of motor needs in the air-conditioning industry, one need was continually emphasized by potential users: Motors available were only guaranteed for one year; what was needed was a motor having a guarantee for at least five years. Other components of the air-conditioning units, such as compressors, are guaranteed for that period of time. A five-year guarantee on the motor would represent a big advantage to ultimate users in increased reliability.

Making this need a basic requirement, the design engineers developed a motor with a new bearing and lubrication system. Self-aligning bearings incorporate a steel-backed, babbitt-lined sleeve, mounted in a spherical cup of sintered metal. The bearing and cup have windows that assure positive contact between an oil wick and the motor shaft. Each bearing reservoir provides ample lubrication for at least five years of normal operation.

Production Approach

A major business problem is that these motors are directed to a seasonal market. To combat this, the plant produces at a fairly even level the year round, stocking in slack months for peak demands.

The plant is operated on a daywork basis. A paced conveyor system, combined with safe and convenient work stations, enables the plant to operate efficiently.

The use of automated manufacturing equipment

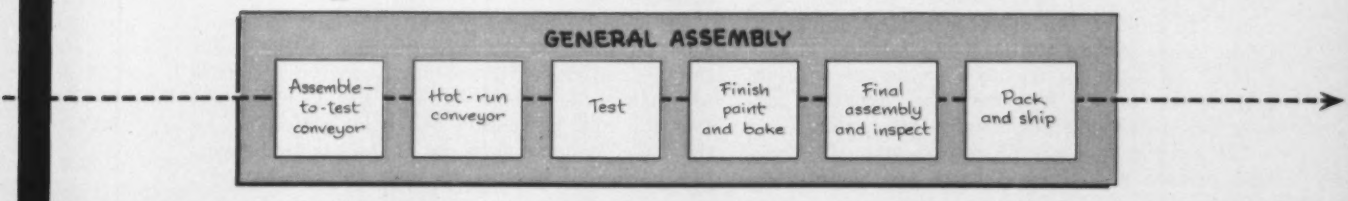


Fig. 2—Ten-station Verson transfer press blanks, forms, pierces, and trims end bells—performing all machining operations required except drilling of oil and drain holes in end bells for certain styles of motors. If a part sticks in a die and fails to make electrical contact in a safety circuit wired to all "hands" of transfer mechanism, press will stop before making another stroke.

insures a uniform high-quality finished product. Work-in-process is conveyorized until it becomes a finished product ready for shipment. The plant is laid out with conveyor capacity to provide temporary storage between operations where neccessary, thus minimizing handling of material-in-process.

Motor parts in the new plant are manufactured in five basic component production lines: End bells, laminations, shafts, stators, and rotors, *Fig.* 1. The major lamination and shaft lines are automatic from start to finish; the other lines are highly conveyorized and utilize automatic cycling machinery for most operations. An assembly conveyor passes the end of each component line, picking up completed parts. By the time the conveyor passes over final assembly work tables, two complete sets of motor parts are on each rack of the conveyor.

End Bell Production

A de-reeler passes 7¼- or 7¾-inch-wide coil stock through a straightener and roll feeder to a 600-ton automatic transfer press, *Fig.* 2. This machine uses a ten-station die system to blank, form, pierce and trim end bells at a rate of 25 per minute.

A shuttle-type transfer mechanism runs the length of the press. After each operation of the press, a pair of "hands" closes on each end bell from two sides, moves it one step, positions it accurately on the die, retracts, then the mechanism returns to its original position. A safety circuit shuts off the machine if any end bell is not properly positioned prior to the transfer portion of the cycle. To protect the operator against injury, a photoelectric system shuts off the machine if any part of his body approaches a dangerous position with respect to the machine. The completed end bells are delivered automatically into crates.

The bearing caps are formed on manually-operated presses and finished parts are loaded into

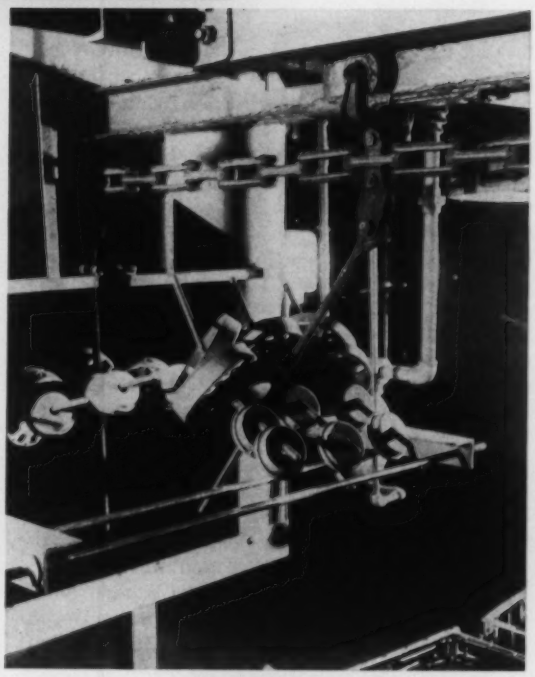


Fig. 3—End bell and cap stampings go through washer and dryer on opposite sides of trolley conveyor hangers. As hangers come out of dryer they are tilted by two horizontal bars and the caps fall automatically into wire baskets below. End bells go on. Should special circumstances of production scheduling require that end bells be run on both sides of hangers, horizontal bars are removed and no parts are discharged at this station.

baskets.

An operator manually loads the end bells and caps on chain-driven hangers that carry them through an automatic washing and drying process to remove die compound and add a phosphate coat for rust prevention and paint adhesion. As the loaded hangers move out of the gas-fired dryer, two horizontal bars at the exit tilt the hangers,

Fig. 3, letting the caps fall into baskets, which are forwarded to the end bell assembly area.

The end bells are automatically stripped from the conveyor later, and slide down a chute into a hopper at the paint station. The end bells are manually loaded on conveyor-driven rotating pedestals. The inside of the end bell is painted with lacquer and air-dried automatically. The freshly painted end bells are then transferred to a storage conveyor.

At the assembly area oil and drain holes are drilled in the end bells by a semiautomatic pneumatic drilling machine.

End bell assembly is simplified by a special wicking, bearing assembly, and oiling machine. This machine consists of a hydraulic press, a 12-station indexing table, automatic oil tube inserting device, two oil measuring and oiling stations, and a bearing cap orienting and inserting device. The component parts are manually positioned and automatically oiled, assembled, and then automatically transferred to grommet inserting and bearing cap staking machines. These machines consist of four-ton presses and fixtures and are semiautomatically operated. Studs, when required for customer-mounting purposes, are added using pneumatic screwdrivers and table fixtures.

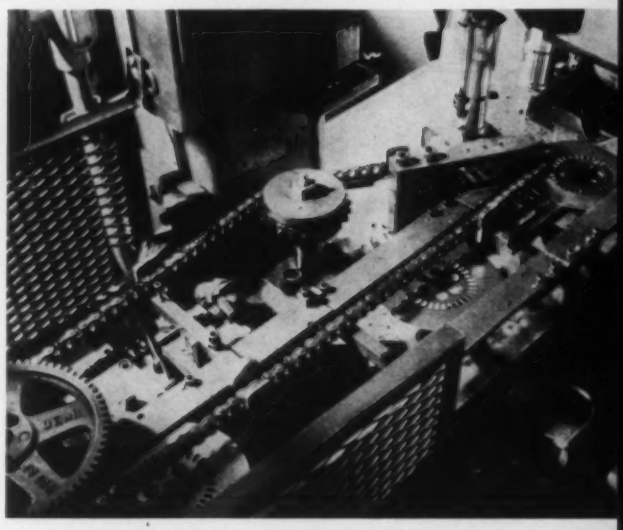


Fig. 5—Chain-driven dogs take rotor-pierced laminations into die on press that separates the rotor and stator punchings. Though press normally requires no operator, complete guarding is used as a safety measure to protect plant personnel.

Completed end bells are then manually transferred to the general assembly conveyor.

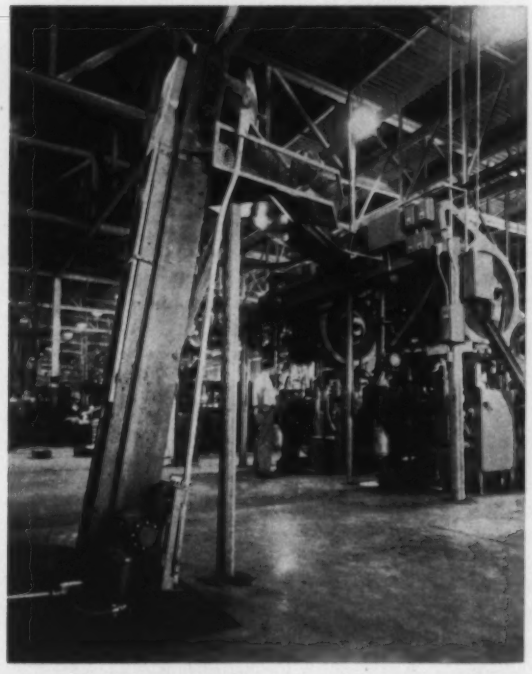


Fig. 4—Lamination blanks from press (not visible to left of picture) fall into specially shaped hopper which positions them for pickup on Homer magnetic conveyor that lifts them to overhead conveyor that feeds distribution system supplying two lamination press lines. Minster presses, shown side by side, are both first presses in a line. Blanks drop into tube-type hoppers and are thus automatically stacked for bottom feed escapement into presses.

▶ Lamination Production

Lamination processing is completely automatic after coil stock is manually loaded onto a de-reeler. Stock is roller fed to the punch press. This press blanks eight punchings (called cookies) per stroke at a rate of 33 strokes per minute.

Cookies fall into a specially shaped hopper, which positions the cookies automatically for pickup on a nearly vertical magnetic belt, *Fig.* 4. The belt transfers the cookies to an overhead conveyor which moves them to the tube-type feed hoppers at the start of the two lamination punching lines. There are three presses in each line. The first press of each line pierces the rotor punching; the second press separates the rotor and stator punchings; and the third pierces the winding slots in the stator.

A sensing device located on the feed hopper of the first lamination press controls the output of the cookie press. When cookies in the hopper reach a predetermined maximum level, the cookie press automatically shuts off until level drops to a predetermined minimum level. Level of punchings in feed hoppers for number two and three presses are controlled in the same way to control operation of each preceding press.

Cookies are stripped from the feed hoppers singly by shuttle-type mechanism and picked up by chain-driven dogs which draw the punching over tungsten carbide dies, *Fig.* 5. These presses operate at 124 strokes per minute. The punching is retrieved from the die by a magnetic shuttle-

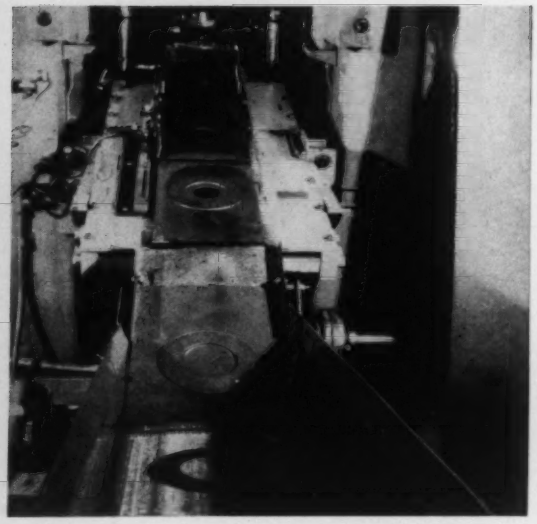


Fig. 6—As the die in press shown in *Fig. 5* opens sufficiently, a magnetic shuttle-type tray enters the opening and retrieves the stator lamination blank. Parts are shuttled onto conveyor which delivers them to feed hopper serving next press.

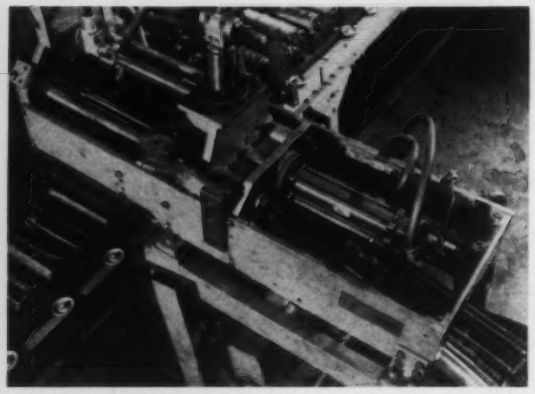
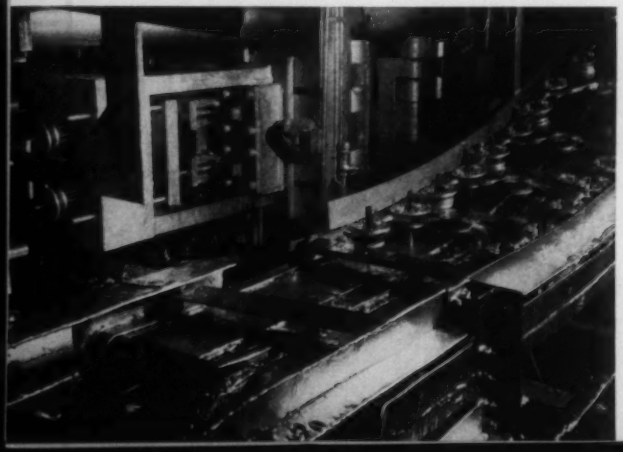


Fig. 7—Rotor punchings from second lamination press are conveyed automatically by a wire tube (right foreground) to annealing furnace conveyor. Here they are automatically loaded onto trays on stainless steel pallets on the conveyor and fed automatically into oven. Stator laminations are also loaded on these pallets and accompany the rotor laminations through the atmosphere-controlled Westinghouse furnace.



type tray, *Fig.* 6, and forwarded to a conveyor which carries it to the feed hopper of the next press. Presses are electrically interlocked to stop automatically when a miscut or other failure occurs.

The rotor punchings leaving the second press are transferred as a long stack by a wire tube and automatically loaded on trays on stainless steel pallets positioned on the annealing furnace conveyor, *Fig.* 7. Stator punchings leaving the third press are conveyed by magnetic conveyor and loaded by hand over bars positioned on the annealing furnace pallets. These bars rise for loading and fall for transfer so that punchings are stacked on edge to prevent sticking during anneal.

When the electrically-fired annealing furnace discharges a pallet at the exit end, the furnace door at the entry end opens and admits another pallet. The atmosphere-controlled Westinghouse furnace is automatic and is arranged to permit idling without attendants on nonworking shifts.

At the end of the anneal cycle, pallets are conveyed to the stator and rotor core areas. Storage conveyors are provided for any pallets of rotor and stator punchings that are not immediately needed. Empty pallets are transferred to a lift and gravity return conveyor.

Underfloor conveyors carry scrap from cookie and lamination presses, through the side of the building, and up an inclined conveyor. An oscillating chute then distributes scrap evenly across the bed of a truck trailer. Other scrap in the plant is loaded into special baskets. These baskets are carried to a scrap area, tilted, and emptied by fork trucks without manual handling by an operator.

▶ Rotor Production

Rotor punchings are assembled in stacks and semiautomatically height-measured at a specified pressure loading by a machine consisting of a press, three-station indexing table and a punching-height indicator. Rotor stacks are automatically oriented by being vibrated over three stationary pins until the pins position vent holes in the laminations.

Rotor skew is obtained by a fixture containing three helical pins that are inserted through the vent holes. Dummy shafts, which are short arbors, are then pressed through the rotor stacks. Using a dummy shaft facilitates subsequent manufacturing operations.

The rotors then are conveyed to the rotor diecasting machine. The stationary face of the die is manually loaded with four rotors. The moving half of the die closes and the cycle is started. Molten aluminum is manually ladled into a well, and the machine takes over. The ram moves in and forces

Fig. 8—Diecasting machine casts aluminum through holes in stacked rotor laminations to form rotor. Die is shown open with retriever arm in act of removing rotors and gating cluster from machine. Delivery to cooling conveyor in foreground is accomplished automatically.

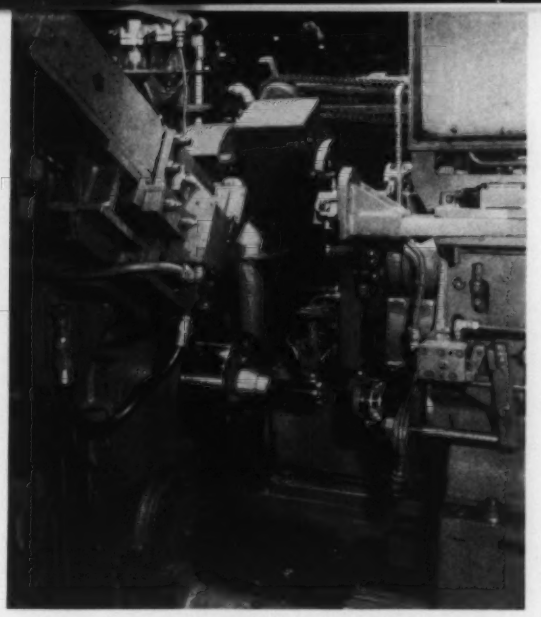


Fig. 9—Automated Gisholt lathe receives rotors from chute at upper left. Three-armed handling mechanism (1) takes a rotor from work arbor and places it in after-gaging station, and (2) takes a rotor from loading chute and places it on work arbor. Tool position is automatically set by feedback circuit. Off-size rotors are sorted out of production flow.

the molten aluminum to all stations of the die. After enough time has elapsed to permit the metal to chill, the die opens and a retriever arm moves into the die area. The rotors are ejected from the die onto fingers of the retriever arm, *Fig.* 8. The arm retracts and deposits four rotors held together by gating onto a cooling conveyor, which takes the parts around the machine, back to the operator.

The diecasting machine operator removes the die-cast rotors from the conveyor and places them on a hydraulic trimming press that automatically strips the die-cast rotors from the gate and presses the dummy shafts from the rotors. The rotor is then automatically fed through a conveyor to an automatic turning machine, *Fig.* 9, which automatically loads, turns, gages, adjusts tools, and unloads the part.

The turning machine has a three-position fixture on the tailstock. It strips the rotor from the incoming conveyor, then rotates 120 degrees and presses the rotor on a fixed arbor, and the outside diameter is turned. After the turning operation, the fixture rotates another 120 degrees and positions the rotor on an automatic air gaging device. If the rotor is gaged over or under, it drops into one of two reject troughs. If the rotor is gaged within tolerance, it drops into a chute that leads to the post-heat oven.

On this lathe a circular tool having 48 indexed stops is used. This is a tool with 48 cutting edges. If a part gages off-size, the tool automatically indexes to a new position. This is accomplished through feedback control from the air gage. If the machine cannot bring parts back into tolerance, it automatically shuts itself off.

The post-heat oven improves electrical performance of the completed rotor. It also expands the rotor for a shrink fit assembly over the rotor shaft. The rotors are loaded into the oven, cycled and retrieved from the oven automatically. The shaft is manually assembled to the rotor and the rotor then automatically transferred to a conveyor. The rotors are retrieved automatically from the rotor conveyor by a unique elevator device, *Fig.* 10, and transferred to a lower level to the general assembly conveyor. This device automatically adjusts itself for different shaft lengths.

▶ Stator Production

Stator punchings are assembled into core stacks and pressure-measured by a machine consisting of a press and punching-height indicator. A considerable quality improvement has resulted compared to the conventional method of weigh-measuring core stacks. The core stacks are placed on a four-station indexing table and laminations are automatically oriented by filtering over rotating bullet-shaped arbors, *Fig.* 11. As the lamination spins and slides down the arbor, a small keyway on its outside edge matches with a key on a stationary fixture at the station. Rivets are then manually inserted in the stacks.

The stator core is then transferred to a riveting machine consisting of a press and fixture. The stator cores are manually loaded and the rivet cycle and workpiece unloading is automatic. This press also burnishes the inside diameter during the riveting cycle.

To insert slot insulator cells in the permanent-

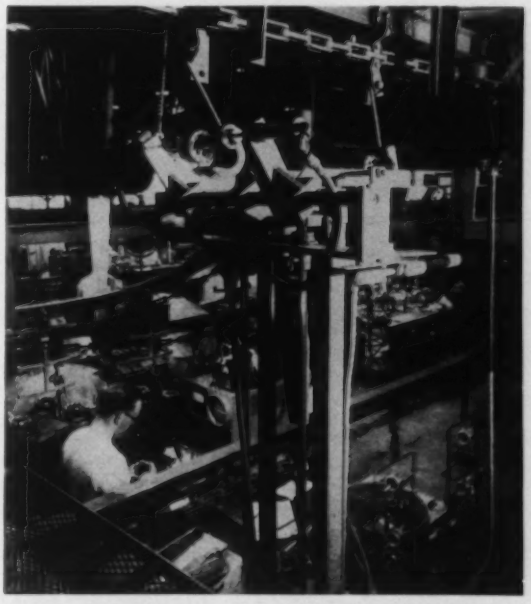


Fig. 10—Rotors are automatically retrieved from upper conveyor by unique elevator device and transferred to the assembly conveyor at a lower level.

split capacitor stator core, the core is manually loaded into an indexing fixture. The cell is formed from coil stock, cuffed, and inserted into core slots automatically

The shaded-pole inserting machine for the shaded-pole motors consists of a ten-station indexing table, copper-coil inserting device, crimping and welding station, *Fig.* 12. The core is manually loaded and the remaining machine cycle is automatic.

The stator winding area is divided for the shaded-pole and permanent-split capacitor designs and a complement of winding machines and work area is provided for each. The winding machines consist of a three-wire needle bar, an indexing chuck, turns counter, and a device to control wire tension, *Fig.* 13. Coil-winding forms are manually installed on the stator core, the core is positioned in the chuck, and the winding of all poles is automatic.

Where Thermoguard over-temperature protectors are used, the Thermoguard is inserted manually in the winding. The winding coils are connected and leads added as required, using the wire-twist, acetylene-burn-off method. The winding end-turns are shaped on a hydraulic press using a shaping fixture. The stator winding is tested for *Shorts, Grounds,* and *Opens* by comparison with a standard core, using the surge method.

Stator insulation varnish impregnation is automatic. The wound stators are supported on their outside diameter on chain-driven conveyor hooks, and six stators are dipped simultaneously in a rise-and-fall varnish tank and conveyed through a gas-fired varnish-baking oven.

From the baking oven, the stator cores are conveyed automatically to two lathes that turn end-bell fits on stator ends. The stators are removed manually from an overhead conveyor at the lathe site. The core is supported by an expanding arbor, the machine tailstock supports the arbor and shields the winding, and the cutting cycle is automatic. The finished stator is placed on the general assembly conveyor.

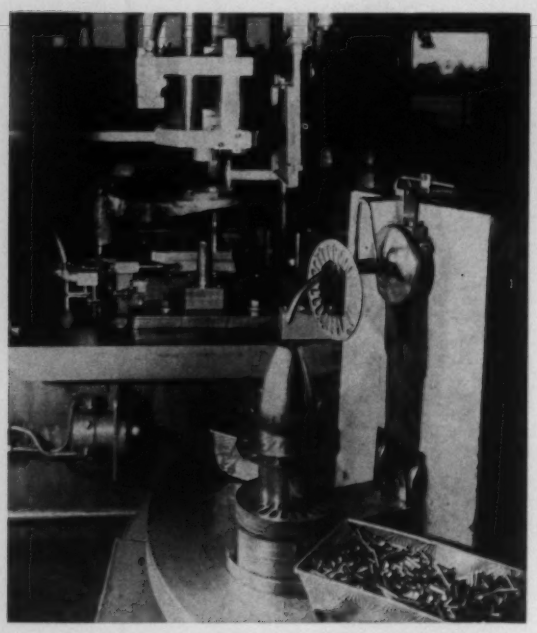


Fig. 11—After pressure-measuring the height of a stack of stator laminations, operator places that stack on a horizontal spindle on this four-station indexing table. Laminations feed off spindle onto one of four rotating bullet-shaped arbors that angularly orient each punching by a keyway notch on its outside diameter. Operator places rivets in holes and transfers stack to Hannifin press (background) that simultaneously stakes rivets and burnishes inside diameter of stack. Retriever arm unloads rivet press while operator goes back to pressure-measure next stack.

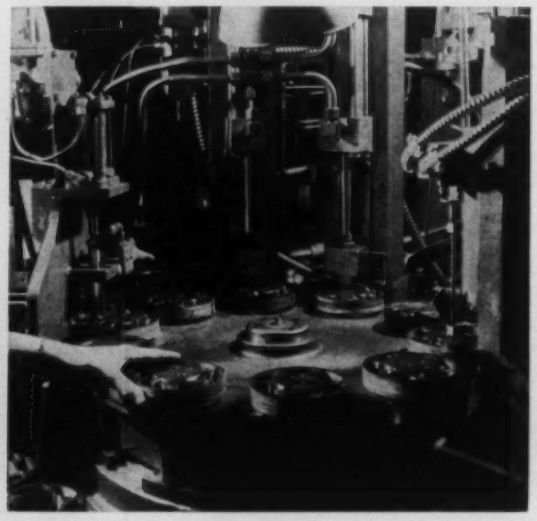


Fig. 12—Westinghouse-designed machine for inserting shaded poles consists of a ten-station indexing table, copper-coil inserting device, crimping and welding stations.

Shaft Machining

Shaft machining is completely automatic. A large supply of shaft stock in 10-foot lengths is loaded on an automatic feed mechanism that places the bar on an automatic bar machine where it is chamfered and cut off to correct lengths.

The bar blank is chain-transferred to and between two centerless grinders for rough and finish grind. The finish-ground shaft is chain driven to an automatic straddle mill where flats are machined. The

Fig. 13—Operators on stator-winding lines receive cores from trolley conveyor, install winding forms, and position cores in chuck of Westinghouse-designed winding machine at operator's right. These winding machines for permanent-split capacitor motors consist of a three-wire needle bar, an indexing chuck, turns counter, and a device to control wire tension. Winding of all poles is automatic.

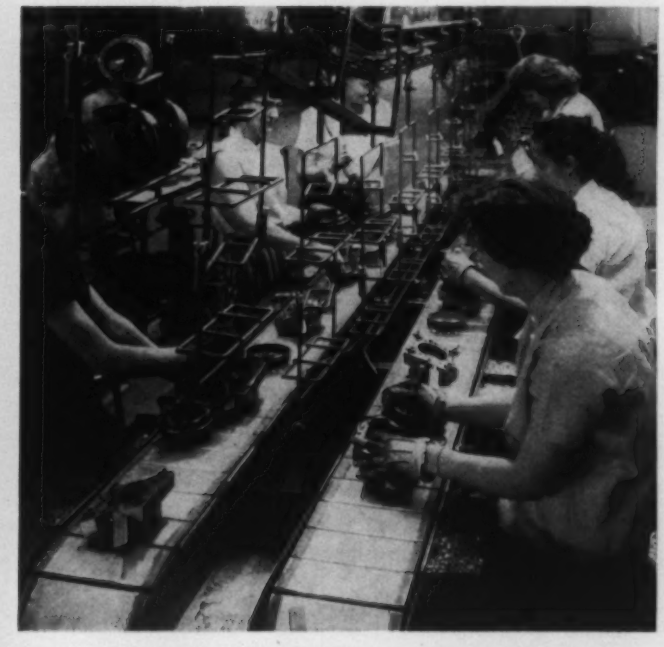


Fig. 14—Each rack on the general assembly conveyor carries two complete sets of motor parts between the two 3-station assembly lines. At end of assembly, conveyor motors are connected to test conveyor. Motors run and reach operating temperature en route to soundproof test booth where electrical and noise characteristics are checked.

finished shafts are stored until ready for shrink assembly of the rotor core.

▶ General Assembly

All components of the motor are received at the general assembly area on a single conveyor. Each hanger rack on the conveyor contains components for two complete motors. There are two assembly lines, each three-station. The conveyor moves between the two lines directly over the work stations, *Fig.* 14, so that parts can be removed by first-station operators.

The first operator positions one end bell, the rotor, and the stator on a belt-driven fixture. The second operator positions the second end bell, feeds the leads through the lead hole and inserts the through bolts. The third operator uses a three-headed pneumatic tool for running the screws, checks end play, and connects the assembled motor to the test conveyor. This test conveyor carries the assembled motor into the soundproof test booth. Enroute, the motor reaches normal operating temperature for subsequent tests and is automatically checked for *Grounds*.

Fig. 15—After final electrical tests, dust caps are added. Motor is placed on conveyor-driven rotating pedestals of Binks system, and automatically sprayed with enamel and cycled through paint baking oven.

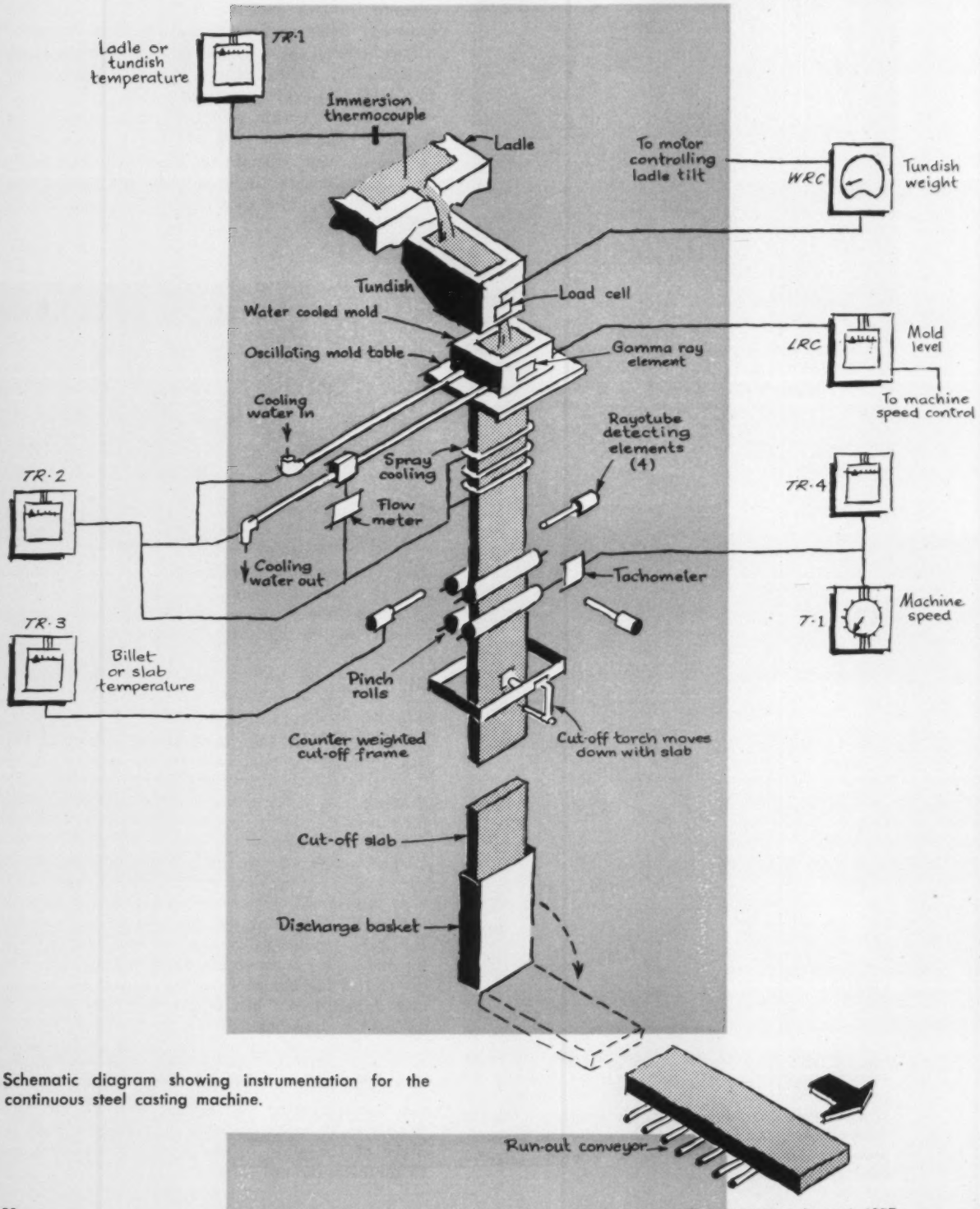
The soundproof test booth is provided for checking electrical operating characteristics and noise.

At the finish paint area, dust caps are assembled. The motor is placed on conveyor-driven rotating pedestals, automatically sprayed with enamel, *Fig.* 15, and cycled through the paint baking oven. At the end of the baking cycle the motors are cooled, identifying decals are added, and the motor is packed for shipment.

This new plant that uses the latest developments in automation techniques represents the results of considerable engineering effort on the part of the manufacturing engineering staff of the company's small motor division, and gives a good insight of the state of the art of automation for motor manufacture.

STEEL CASTING PROCESS HAS

CENTRALIZED CONTROL



Schematic diagram showing instrumentation for the continuous steel casting machine.

OF PROCESS VARIABLES

IN ANY manufacturing process, the complexity of control increases with the number of process variables which have to be regulated. When many variables are involved, and when the same equipment is used to produce a variety of product types, each type of which requires special operating conditions, the problem of control is still more complicated. The centralization of measuring and controlling facilities is one solution, and is the one adopted for the continuous steel casting process at the Welland, Ont. plant of Atlas Steel, Ltd. Here, the indicators and recorder-controllers which monitor and control casting conditions are grouped on a common panel board to provide greatest effectiveness of control.

The casting machine, *Fig.* 1, designed and built by Koppers Co., continuously casts and cuts billets or slabs of high-speed, stainless, alloy and tool steels. Although basically simple in principle, the operation requires precise control of such variables as molten and solid metal temperatures, molten metal level, machine speed, and cooling water temperature and flow rate. Faced with these process variables during tryout, Atlas engineers made good use of the instrumentation, *Fig.* 2, to guide their initial test runs and obtain valuable chart records for establishing best operating conditions. For production runs, operators depend almost entirely on their recorders and controllers for successful operation. Despite its obvious importance, the cost of instrumentation represents only about one per cent of total equipment costs.

The schematic diagram at left summarizes the instrumentation originally furnished by Leeds and Northrup, and also the Brown controls added later for ladle tilting and level measurement of molten steel in the mold. As received from the furnace, temperature in the ladle varies between 2750 and 2850F according to the grade. When the ladle arrives at the machine, the operator checks the temperature with a standard immersion thermocouple unit *TR*-1, which is connected to a recorder on the control panel. A signal light system assures that the operator takes a proper measurement and also tells him when the measurement is completed. He then marks the heat number on the chart opposite the temperature record. The operator uses this same immersion thermocouple to check temperature in the tundish into which the molten metal is poured from the ladle. He also uses it to make occasional checks of the metal temperature in the mold.

A Baldwin SR-4 load cell mounted under the tundish measures weight of molten metal in the mold and, in effect, indicates the metal level in this reservoir. Based on the weight measurement, an automatic controller, *WRC*, adjusts the ladle tilt by means of an electric motor. This con-

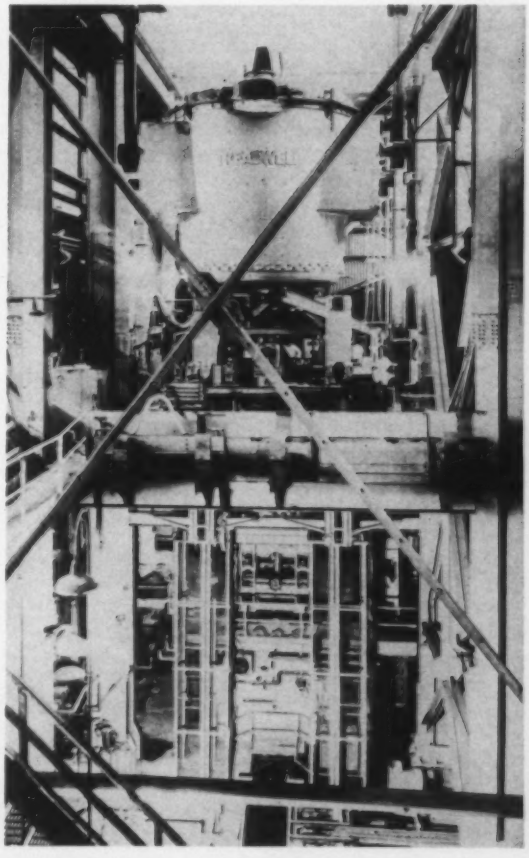


Fig. 1—Four-level continuous casting machine at Atlas Steel, Ltd. casts and cuts billets and slabs of tool and special alloy steels.

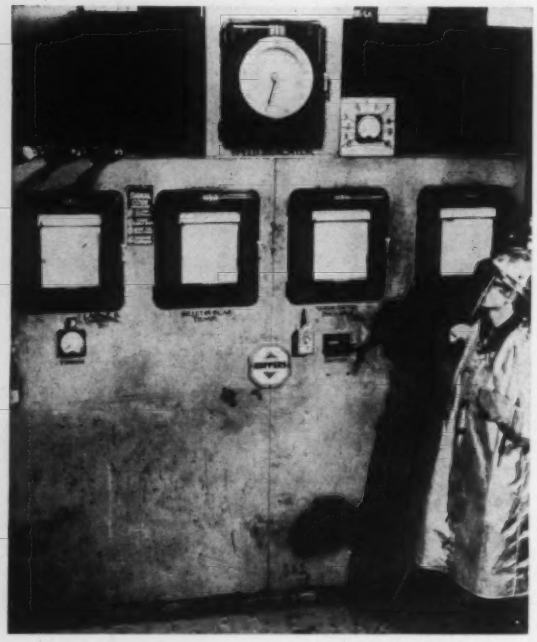


Fig. 2—Instrument and control panel by which process variables and setup conditions are monitored and controlled.

trol functions to hold a constant head of molten steel in the tundish in the face of varying casting speeds. Manual control of ladle tilt is also provided so that the molten metal level in the tundish can be set by visual observation.

The operator manually regulates machine speed according to level in the mold, maintaining the level about 2 to 4 inches below the top edge. Atlas added a gamma-ray type measuring instrument connected to recorder-controller *LRC* which has been used successfully on an experimental basis to automatically regulate the machine speed. When used, this control speeds up the machine as the level of molten steel rises, and, conversely, slows down the machine as the level falls. This variation is slight, however, because of the virtually constant supply of molten metal from the tundish.

Mold and Spray Coolant Recorders

The water-cooled mold partially freezes the molten metal to form a thin shell for the casting. Oscillation of the mold, synchronized with machine speed by a cam-operated controller, keeps the shell free as the metal moves through the mold. A continuous and proper rate of cooling water flow is obviously important in this critical operation. Thermocouples connected to a multipoint, panel-mounted recorder measure both inlet and outlet cooling water temperatures. A flow meter measures the water flow rate, and records its value on recorder *TR*-2. The operator can thus check mold cooling water conditions at the panel board. Below the mold, water sprays perform the important function of cooling the casting as it moves downward toward the pinch rolls. Complete and uniform cooling is essential. Here, too, thermocouples measure both inlet and outlet spray water temperatures and record these values on the same multi-point instrument (*TR*-2) that records mold coolant temperatures and flow rate.

Below the spray cooling chamber, four L&N Rayotube detecting elements sight on the four sides of the moving slab, measuring temperatures which have dropped now to about 1600F. These temperatures are logged on a panel-mounted Speedomax recorder, *TR*-3. The casting at this point should be solidified entirely. Above this, the molten metal inside the casting shell should be in the shape of an inverted cone with its apex at the center of the slab. Surface temperature measurements on all four sides check that the slab is uniformly cooled. Atlas finds the radiation type instrument ideally suited for this measurement problem because it responds almost instantaneously to temperature changes and can measure the temperature of steel as it moves. Increased machine speed offers no problem for accurate measurement.

A tachometer-generator geared to the rotating pinch rolls is connected to recorder *TR*-4 and also to a large dial-type indicator, *TI*, both mounted on the panel board. This records in inches per minute the actual machine speed for each production run, providing a valuable permanent record of daily production.

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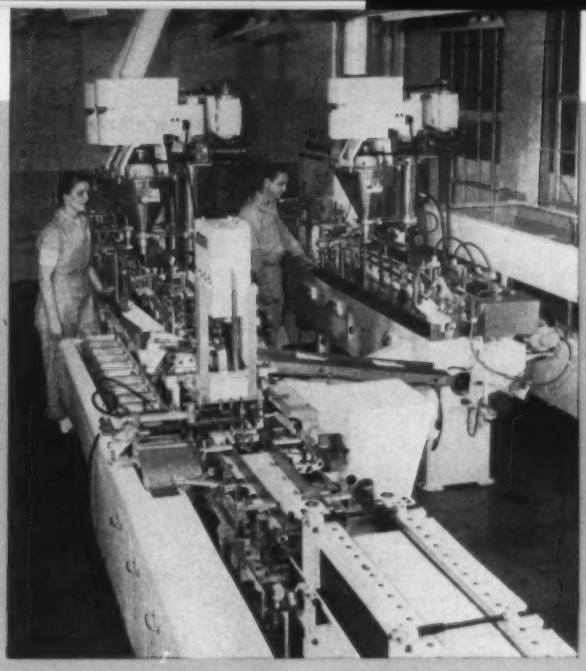


Fig. 1 — Fully automatic packaging machine installation built by Bartelt Engineering for the Jewel Tea Co. has two filling lines and a cartoning line. Operators watch to see that job is running smoothly.

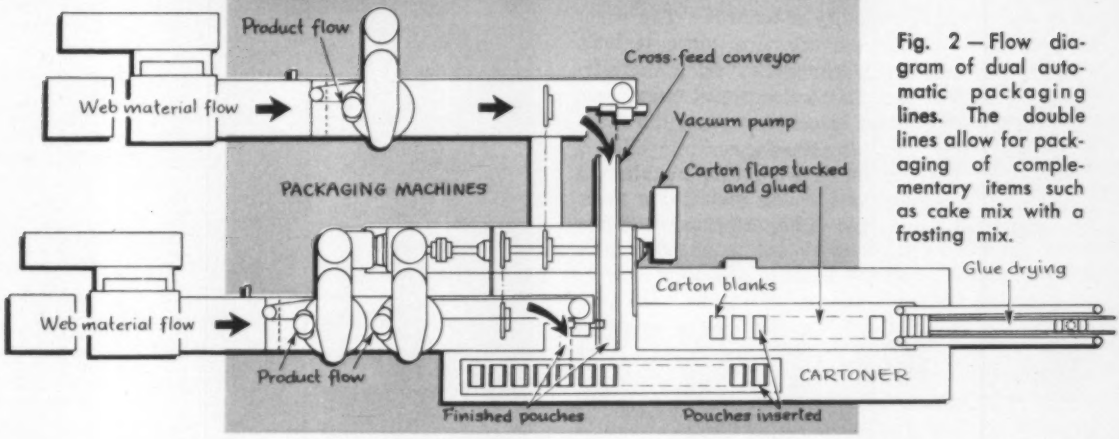


Fig. 2 — Flow diagram of dual automatic packaging lines. The double lines allow for packaging of complementary items such as cake mix with a frosting mix.

STRIP PACKAGING LINE

HANDLES VARIETY OF FOOD PRODUCTS

SHORT RUNS are not strangers to the food industry, but as in many other industries, they are less publicized than the more glamorous high production runs. However, automation has demonstrated its ability to help the short run as well as the mass producer; the food industry has capitalized on this ability and can boast short run success stories.

Installation Requirements

Precise positioning, accurate filling, and a relatively high hourly production rate in a line that must also have the advantage of flexibility for rather frequent changeovers is the combination of difficult conditions posed by the newest packaging line in the Jewel Tea Co. Inc., Barrington, Ill. plant. These conditions have been met by automation. Production runs on this line are considerably shorter than in many food industry installations, since the company sells its products exclusively through approximately 2000 retail route men and usually does not use other retail outlets.

The fact that a lower volume is being packaged does not alter the requirements that the job be done at a high level of efficiency, and that changeover must be relatively simple and fast. The

packaging line, designed and built by Bartelt Engineering Co., Rockford, Ill. consists of two lines that can be operated together or independently, and with or without using the attached cartoning line, *Fig.* 1. Contributing to the required precision during the packaging cycle and to quick changeover is a total of seven electric brakes and clutches made by Warner Electric Brake & Clutch Co., Beloit, Wis. The amount of attention to this machinery required on the part of Jewel Tea's maintenance force is reduced with this form of power transmission.

The packaging lines are set up in a special air-conditioned room because some of the products being handled by the line would otherwise absorb moisture from the atmosphere and thus fail to meet the company's quality standards. The room is kept under slight air pressure, since it isn't practical to seal it off completely from the surrounding work areas due to the use of conveyors, etc. Movement of air is outward from the room housing the new packaging lines.

Basically, the Bartelt line in this installation consists of two package forming and filling lines, one with two hopper-fed filling stations, and the second with a single filling station, *Fig.* 2. Pouch stock material varies slightly, depending on the specific food product being packaged. Most heat-sealing papers, foil or film, can be used on the line. The package is formed, sealed on both edges, cut, filled, and finally sealed at the top. If desired, the tooling could be changed slightly to add a bottom sealing operation that would be performed at the same time as the sealing of both sides. Packages from both lines then come together at the end and can be placed into cartons, if required. With the two lines, it is possible to handle complementary items—a cake mix and frosting mix, for example—and then have them come together for gathering into a single carton.

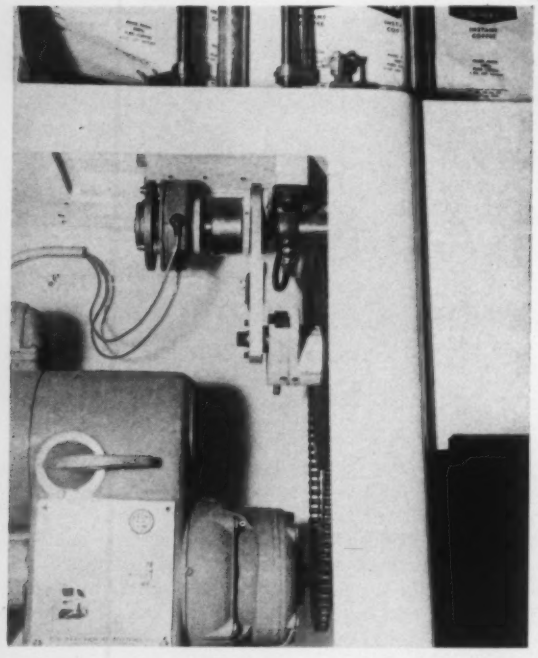


Fig. 3—Preprinted web passing above variable-speed motor which provides power for machine drive. Brake is mounted at end of feed roll drive mechanism directly above drive motor. It controls width of pouch formed from the web.

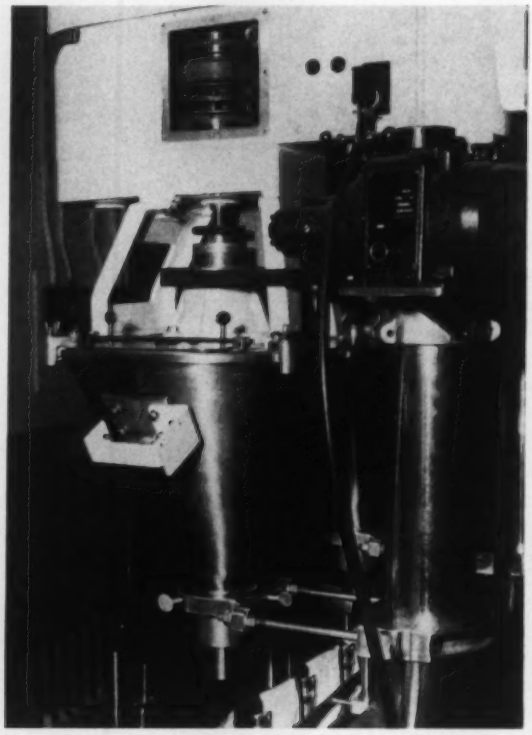


Fig. 4—Cover plate removed to show clutch-brake that controls operation of auger. Precise metering of quantity of food product is possible because of quick, positive action of clutch-brake.

Drive and Control

Main drive for the packager is from a ¾ hp variable-speed motor with the output shaft speed ranging from 47 to 190 rpm, turning the cycle shaft which controls operation of the entire machine, *Fig.* 3. Feed of the packaging material is governed by the register brake assembly consisting of a Warner brake and the necessary mechanical

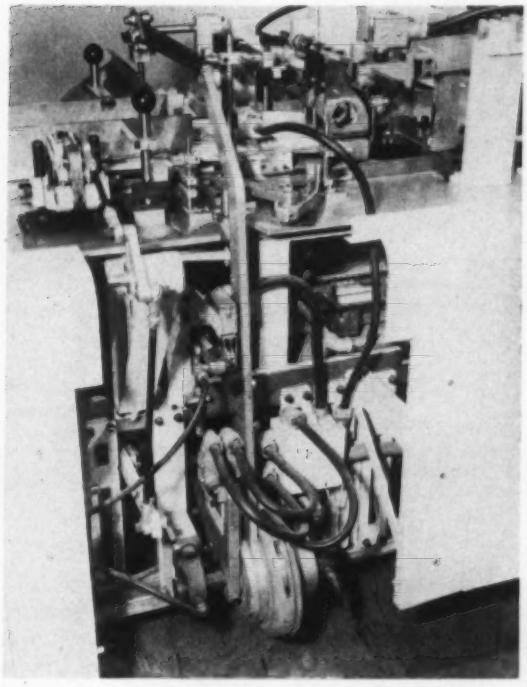


Fig. 5—Cartoner at end of Jewel Tea packaging line. At this station cartons are formed and pouches are inserted. A Warner clutch controls operations of arm on cartoner that inserts packages into cartons.

linkage. The brake serves two purposes—it brakes the feed roll drive to hold and co-ordinate the pouch width with the printing on a preprinted web, and prevents the feed roll drive from reversing.

When running a printed web, the register brake is actuated by a registering device using a photoelectric cell setup. A limit switch, operated by a cam on the cycle shaft, keeps the brake engaged for half of each cycle shaft revolution. When either a blank web or one with continuous printing is being run, then both the actuation and holding are controlled by the cam and limit switch.

After the package is formed and sealed, it is cut off by steel knife blades to a predetermined size. In order to open the pouch so that it can be filled, splitter blade with built-in air jet enters from the top immediately after the cutoff operation. The air jet overcomes any tendency of the sides of the package to stick to each other.

▶ Package Filling

For the filling operation, flex blades are inserted into the top of pouch to hold it open. The flex blades are inserted closed but bow into a convex shape under tension permitting a large enough opening to be formed for the filling operation.

When a filling line with two hoppers is used, the first hopper fills the package half full. The second finishes the filling operation to the precise limits required.

This precision in filling the pouch is possible because of the feeding mechanism designed into the Bartelt line. Material is fed positively by an auger that meters out the exact amount desired. The filler drive-motor runs constantly and is connected to the auger through a V-belt drive and a clutch-brake, *Fig.* 4.

A cam on the cycle shaft actuates a limit switch to control the operation of the clutch-brake. During the filling cycle, the brake is disengaged and the clutch engaged, and the reverse happens at the end of the filling cycle. Because the actuation time of the Warner clutch-brake unit is in milliseconds, the amount of product metered out by the auger feed can be controlled to a high degree of precision. Although several different food items are handled by this line, accuracy of weight repetition is readily obtained once the machine is set up for a particular product.

▶ Carton Making and Filling

After the pouches are filled and the tops sealed, they move automatically to the cartoner, *Fig.* 5. Here, chip board imprinted cartons are formed, the pouches are inserted and the cartons are glued and sealed before going to an exit conveyor that takes them to the shipping department. Another Warner clutch is energized by a cam and limit switch arrangement from the cycle shaft to provide lineal motion from a bell-crank linkage. It is an intermittent motion that can be repeated as many as 60 times per minute and controls the inserting of packages into the carton.

This installation at Jewel Tea not only provides a smoothly functioning line, it also provides one that is remarkably easy to maintain and economical to operate. In addition, the line provides a special contribution of automation to the food industry—elimination of contamination.

What's Your Problem?

DO YOU HAVE a knotty problem in your automatic operations or those you plan to install? The AUTOMATION Problem Forum, a special feature department to be found in the back of this issue, offers a unique service in which you will be interested.

To avail our readers of automation information and to tap the vast reservoir of practical know-how across industry, editorial space is devoted to the presentation of both problems and suggested solutions to the problems. This free exchange of ideas and information, as can be seen from the format of the Problem Forum, can be accomplished to mutual advantage. Why not take advantage of this service—what's your problem?

NEWSPRINT HANDLING SYSTEM

FEATURES SPEED AND SAFETY

SUPPLYING large quantities of newsprint on schedule to the presses is vital to the operations of a modern newspaper. To accomplish this, an efficient materials handling system can be an important aid. At the remodeled plant of the Pittsburgh Sun-Telegraph, newsprint is received, routed to storage, and delivered to the press room by an integrated five-way interfloor

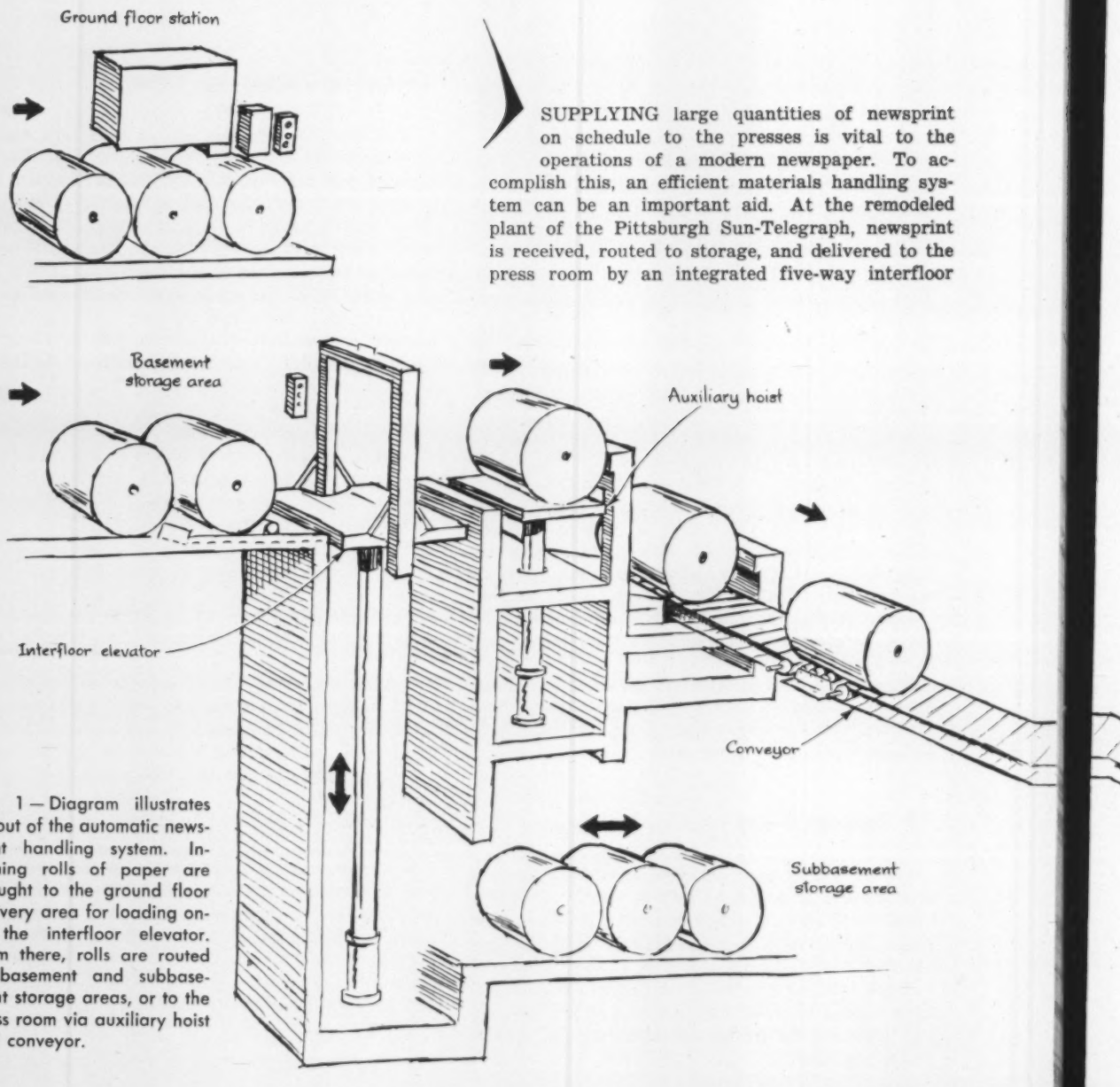


Fig. 1 — Diagram illustrates layout of the automatic newsprint handling system. Incoming rolls of paper are brought to the ground floor delivery area for loading onto the interfloor elevator. From there, rolls are routed to basement and subbasement storage areas, or to the press room via auxiliary hoist and conveyor.

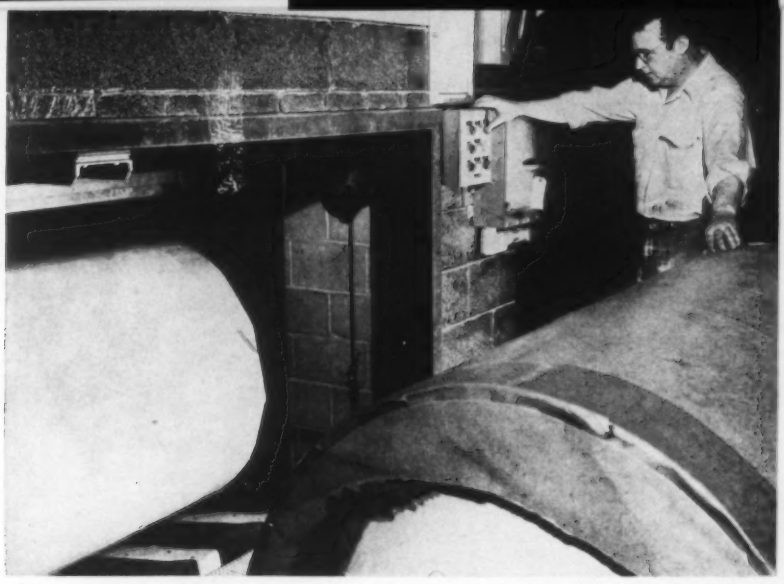


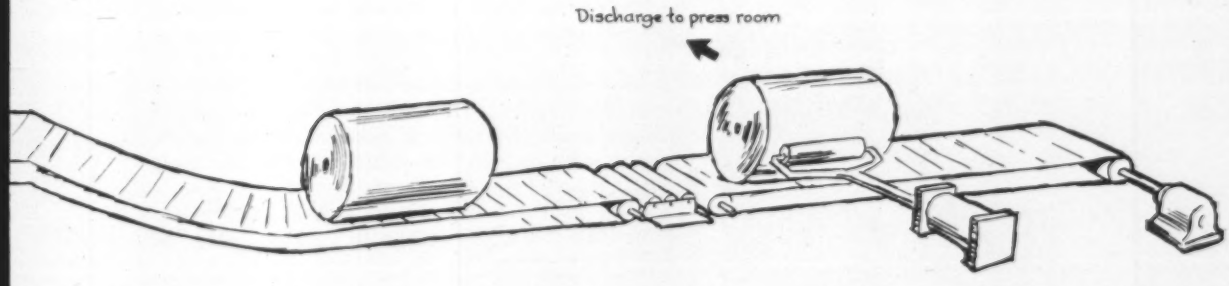
Fig. 2—View of the ground floor station showing a roll of newsprint in position on the interfloor elevator. Operator sets panel controls to determine delivery point for the roll.

handling system. The automatic system is fast, safe, and it gets newsprint where it's needed, when it's needed. Designed and built by the Gifford-Wood Co., the system, *Fig.* 1, includes: A two-way interfloor elevator operating in a 40-ft shaft; an auxiliary transfer hoist; a conveyor which has a roll-ejecting device at its press room terminus; and such auxiliary components as electrical controls and safety devices.

The system handles newsprint rolls weighing up to 2,000 pounds and as large as 40 inches in diameter by 30½, 45¾ or 61 inches long, routing them over the following paths: (1) ground floor delivery area to basement storage area; (2) ground floor delivery area to subbasement storage area; (3) ground floor delivery area to press room; (4) basement storage area to press room; and (5) subbasement storage area to press room. All of these movements are controlled from pushbutton panels at the several stations, and the only personnel required are a man at the loading point to set the system in operation and a man at the receiving station to take away the rolls. The longest time to transfer rolls between any two stations is two minutes. The new system, which replaces handling by fork truck and freight elevator virtually eliminates the possibility of employee injury and damage to expensive rolls of newsprint through handling accidents.

▶ Operation

Rolls of newsprint are delivered to the receiving area by truck. A hydraulic conveying mechanism carries the rolls to the ground floor station, *Fig.* 2, where they are positioned for loading by means of a large turntable. With the interfloor elevator in position, the operator loads a roll on it and sets a selector switch on the control panel which establishes the level to which the elevator will descend. He then pushes a *Start* button, which sets the elevator in motion at a speed of about 55 fpm. When it reaches its destination, a limit switch is tripped, the elevator stops, and a ¾-hp tilting motor is activated. This tilts the platform of the elevator, and the roll is discharged to the receiving point. Since the basement storage area receives and delivers rolls on one side of the elevator, and the subbasement area and the auxiliary hoist load and unload from the other side, the tilting mechanism in the floor of the elevator has been arranged to tilt to either side. The amount of tilt is adjustable up to 18 degrees so that the optimum



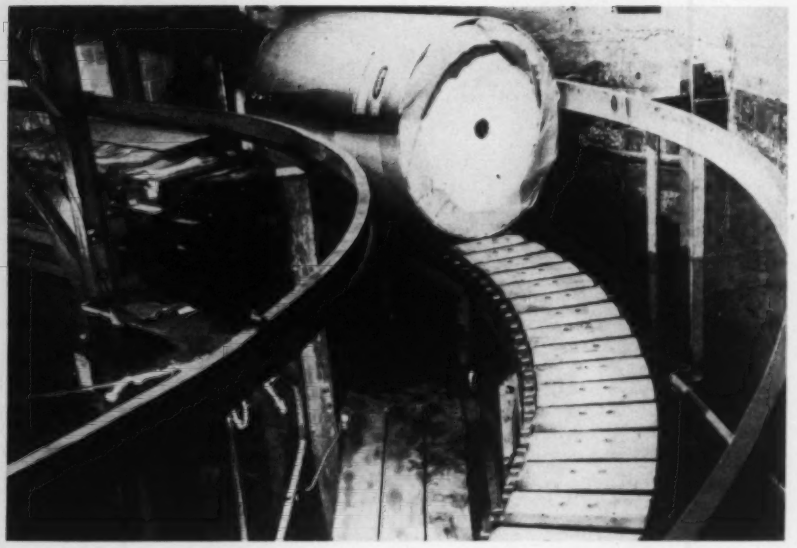


Fig. 3—Curved section of the conveyor. The roll has been transferred from the auxiliary hoist at upper left and is being conveyed toward the press room.

unloading action can be set. After a time delay the elevator returns to its original loading point, ready to receive another load.

The auxiliary hoist and the conveyor are used for delivering rolls to the press room. In this operation, the interfloor elevator delivers the roll to the level of the auxiliary hoist and automatically rolls the newsprint onto the hoist. When the roll is properly positioned, a switch is tripped and the auxiliary hoist is set in motion. It descends about 4 feet to the level of the conveyor, and there a switch is tripped which causes mechanical fingers at the discharge point to transfer the roll to the conveyor. A second switch actuated by the descent of the auxiliary hoist causes the interfloor elevator to return to its original position. After a time delay, the empty auxiliary hoist returns upward to its loading position.

The conveyor includes a short straight section containing powered and free rollers, a 90 degree curved portion and a straight section leading into the press room. The curved portion, *Fig.* 3, contains steel slats attached to a single chain. Each slat has three outboard flanged rollers which ride on supporting tracks. Steel channels on both sides of the curved section serve as guides for the roll. The roll next passes to a series of powered and free rollers which deliver it to the discharge point at the end of the straight conveyor section. Here the roll trips a switch to actuate a discharge pusher, *Fig.* 4. The pusher forces the roll off the conveyor and delivers it to the press room proper. In moving off the conveyor, the roll trips a floor plate switch, which causes the pusher ram to retract to its original position ready to unload the next roll.

One of the safety features of this installation is the provision of fire doors at each of the openings to the interfloor elevator shaft. Doors at the ground floor and subbasement levels are operated by motion of the elevator and the door at the basement delivery point is operated by an electric motor. The door at the opening for the auxiliary hoist is manually operated, and it contains a fusible link that will break in case of fire and lower the door. This action in turn will stop the entire conveyor system.

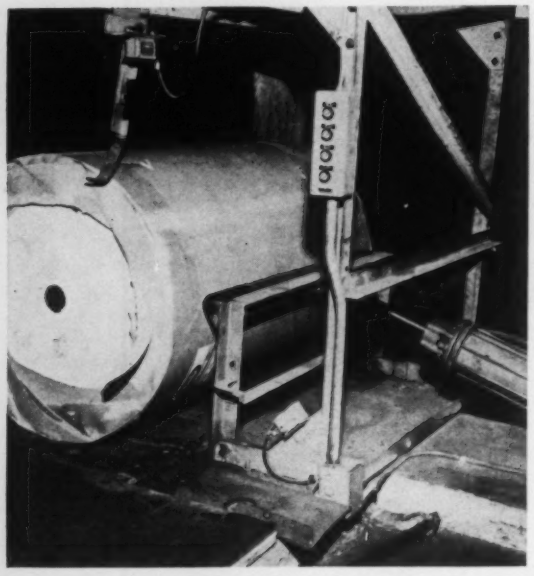


Fig. 4—Delivery point in the press room. The ejecting device is shown pushing the roll off the conveyor. On leaving the conveyor, the roll actuates a switch which causes retraction of the pusher to its normal position.

LUBRICATION OF AUTOMATED MACHINERY

The authors document a phase of automation and suggest, as is so often the case, that successful operations are dependent on workers. Trouble free operation of automatic machinery, in a very real sense, is influenced by the competence of the oilerman as well as properly engineered systems.

By R. F. BALOW and J. R. HICKS
Staff Engineers, Socony Mobil Oil Co., Inc., New York, N. Y.

THE TITLE may seem to imply that there is a great difference between the lubrication of automated machines and that of conventional machines. Actually the difference is only in emphasis. For example consider automated machine tools. Generally, they are multiple-station machines which perform a number of machining or grinding operations in sequence. Where a relatively few operations are required, indexing machines of rotary or trunnion types are used. Where many operations are involved, as many stations as practical are strung out in line and are connected by means of a type of conveyor, or transfer mechanism. The actual machine tools are more-or-less conventional, and they and the indexing or transfer

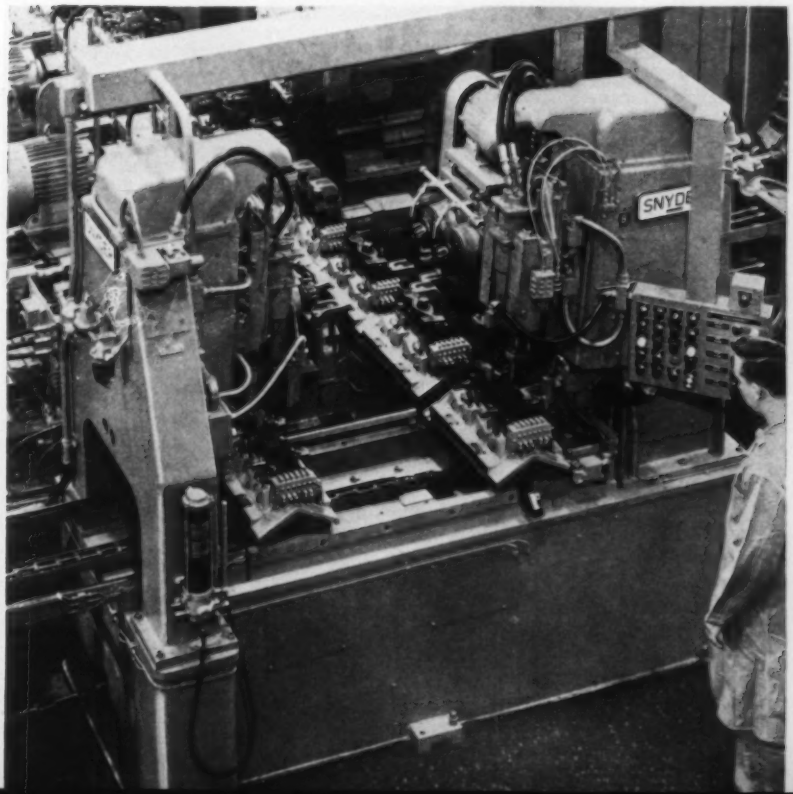


Fig. 1 — Pallets on Snyder transfer machine are lubricated by Trabon circuits built into each pallet. Units are served by periodical connections to lubrication source by operator.

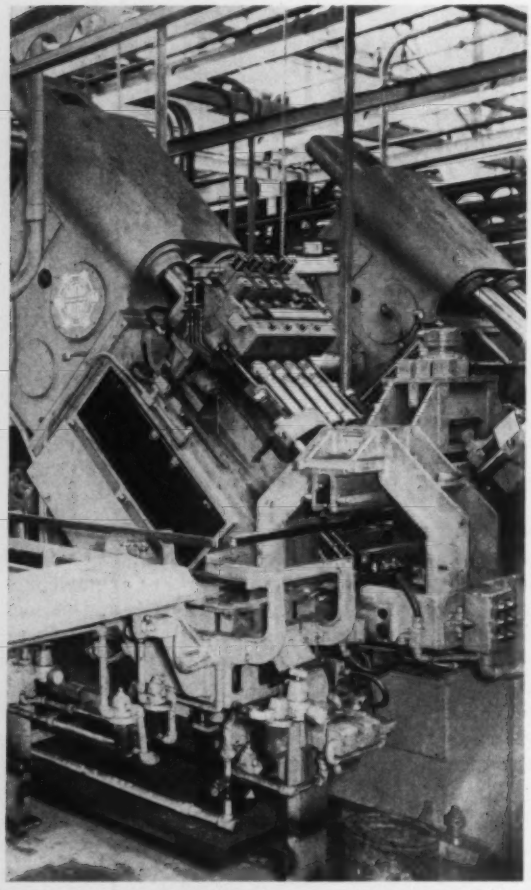


Fig. 2—Micromatic Hone Corp. equipment operates in pairs to rough hone and finish hone up to 100 V-8 cylinder blocks per hour. Lubrication system includes illustrated spindle lubricant circuits and air line lubricators.

mechanisms have the usual bearings, gears, slides, cylinders, chains, etc., that are lubricated by means of standard methods using lubricants that are not special in any way. There is this important difference: With machines that are tied together by conveyor or indexing mechanisms, the failure of any part of any unit may mean shutdown for the entire group—this can be very expensive in terms of lost production. Therefore, for automated machines there is a premium on reliability, and one of the main guarantees of this reliability is planned lubrication, using high-performance lubricants. Planned lubrication should be viewed as a major element of the preventive-maintenance program in an automated plant.

As far as possible, lubrication is made automatic in automated machine tools. All suitable types of central systems are used, including centralized greasing systems, centralized oiling systems of both fluid and oil-mist types, and splash or pressure-circulation oiling systems in which oil is reused many times. Hydraulic systems, which are widely used for the actuation of automated machine tools, are similar in many ways to circulation oiling systems.

Selecting and installing suitable lubrication systems on the various units or groups of units of an automated line is the beginning, not the end, of lubrication. These systems require maintenance, servicing, and inspection just as the machines themselves do. A force of trained men who understand the importance of lubrication is needed for the work. In addition, the lubrication program should be carefully organized all the way from the origin of orders for lubricants through handling, storing, and dispensing to the point of application of lubricants.

The cost of lost production due to unscheduled shutdown for repairs of an automated production machine is so great that the very best in lubrication—systems, lubricants, and men—can be justified.

Points To Be Considered

Automatic machines involve numerous anti-friction bearings, gears, slides, and other parts that require lubrication. The variety of lubrication systems used are indicated by the following examples from the machine tool field:

On one transfer machine for cylinder blocks, the gears and bearings of multiple-spindle head units at each station are lubricated by means of a built-in circulation system. A pump draws oil from a reservoir in the base of the head and delivers it through branch leads to bearings and points of gear mesh. The oil drains back to the base for reuse. A high-quality oil is used that is effectively inhibited against oxidation and can be left in service for long periods. The ways of this machine are lubricated by means of a centralized (all-loss) oiling system, and a high-performance way oil is used to assure smooth, chatter-free tool feeds. Certain grease-lubricated antifriction bearings are relubricated by means of a pressure gun. Leads are run from the bearings to a convenient point where the grease fittings are located.

On another transfer machine for machining V-8 engine blocks, 350 ball bearings and 170 spur gears in multiple-spindle heads are lubricated by means of two large-capacity oil-fog systems. In systems like this, the gears require a heavier-bodied oil, and this guides the selection of the oil that is used.

Anti-friction bearings of certain precision-boring machine spindles are well sealed and are lubricated by premium grease of "packed-for-life" quality. Actually, in severe service, it may be necessary to repack these bearings after one to two years of operation.

Where work pieces are carried on pallets, the moving parts of clamps and other mechanisms can be lubricated through leads from central distributor

blocks. These are located on the pallets so that they can be supplied periodically by means of a hand gun or other pressurized source.

Centralized lubrication systems of several types and makes—including Farval, Trabon, Lincoln, Alemite (Stewart-Warner), Bijur, Norgren and others—are used for the lubrication of automated machines. Oil-mist systems, of course, handle only oil, but most other centralized systems can be adapted to handle oil or grease. Oil is generally preferred, since a greater variety of elements and operating conditions can be satisfied by one oil than by one grease. All of these systems are of *all-loss* type—the lubricant is used only once. With a lubricant that is especially suitable in certain properties such as antiwear value and viscosity, extremely small amounts per application are effective.

A few elements requiring lubrication may be so remote from other points or require so little oil or grease that they cannot conveniently be tied into a centralized system. Such points are lubricated by hand or by means of a device that should be refilled as needed. If the fittings or devices are hidden or hard to get to, these points are likely to be neglected.

The power unit of hydraulic systems should not be overlooked. These are compact units consisting of reservoir, pump, electric motor, relief valve, control valves, filter, sometimes oil cooler, and connecting piping. These units sit apart from the machine tool so that all parts are easily accessible for servicing. The use of a high-quality hydraulic fluid having high resistance to deposit formation greatly reduces maintenance, since systems remain clean and the fluid remains in service for long periods. Such an oil has minimum tendency to thicken in service, and as a result, accurate control and snappy machine response are maintained.

Air-operated devices, such as clamps, are lubricated by means of air-line lubricators. The oil used should not only have proper body and adequate lubricating value, but also should be of the type that will not cause too much swelling or deterioration of seals and packing in air cylinders and control valves.

▶ Maintaining The System

Automatic lubrication systems have taken a lot of the work out of machine lubrication, have made the oilerman's job safer, have reduced costs for both application labor and lubricants, and have provided excellent lubrication *when maintained.*

That central lubrication systems require planned maintenance seems not to be recognized or fully appreciated in some plants. Typically, these are high production plants in which production cannot be interrupted for lubrication work. But it does not need to be. The machines are down periodically for tool changes—sometimes once a shift, or once in two shifts—and lubrication work that requires shutdown can be done at that time. What is needed is an understanding between production and maintenance personnel that certain lubrication work—such as cleaning reservoirs, changing filter elements, replacing defective feeder valves, etc.—must be done and that the work should be fitted into a period when a machine is shut down for production reasons.

With centralized systems, most of the work connected with the application of lubricants can be done while a machine is in operation. For example, reservoirs of centralized systems can be filled and lubricant pumps can be operated. Make-up can be added to circulation and hydraulic sys-

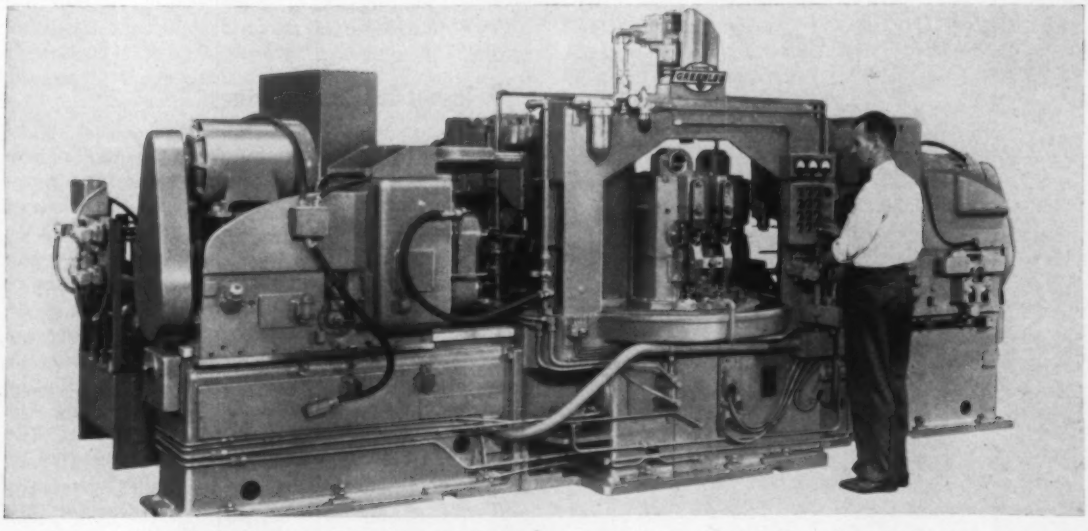


Fig. 3—Special Greenlee four-station indexing machine includes Farval centralized grease distribution system. Grease gun connections permit lubrication of a number of bearings from a single point.

tems. There is only one problem here—to get the right kind of oil or grease in the right place. In some cases, such as with circulation systems and grease-lubricated anti-friction bearings, getting the right *amount* of lubricant is highly important. Too much or too little can cause trouble.

The problem of getting the right kind of lubricant in the right place is tackled in different ways, depending on several factors but finally on the caliber of man available for oilerman—the man who actually puts the lubricant in the reservoirs. With a high-grade, stable, well-trained oilerman force, there is no problem. Men in such a force understand that there are real differences between lubricants, that lubricants are developed for certain ranges of service conditions, and that it is important to get the kind that has been selected into the proper place.

To the extent that lower-caliber or less-well trained men must be used, or where the turnover of labor is greater, the job of lubrication must be organized in more detail. In some plants, it is sufficient to post lubrication charts in the oil house and at various points near the machines to be serviced. These charts list kind, method and frequency of application for all points to be lubricated. In addition, certain points that require special lubricant, or are hard to find, are tagged or identified in some way as to demand attention.

Finally, where inexperienced men of limited capability are used for oiling, or where the labor turnover is so fast that thorough training is not practical, detailed organization and close supervision and control of the work of applying lubricants is necesssary. The tagging, or coding, of lubricated points, just mentioned, must be done for all lubricated points. Tags, painted symbols, or decals are used depending on the desires of the particular plant. A great deal of work is involved in installing a system like this. However, this can be turned into an advantage, since having new oilermen do the coding work under direction is excellent training for them.

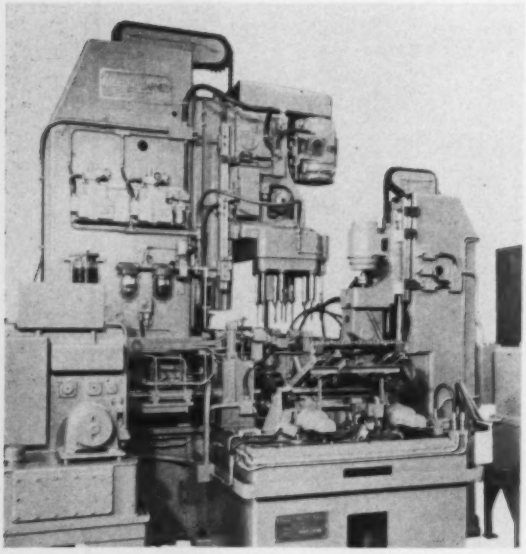


Fig. 4—Sixteen-station transfer machine designed by Krueger-Barnes is equipped with Alemite oil mist lubrication system.

An extremely important part of the job of lubrication is keeping lubricants clean. Contamination of new, unopened drums of oil with water can occur if the drums are stored improperly. Once the drums or other packages are opened in the oil house, they should be kept covered to keep out dirt and shop dust. Dispensing containers including those on the oilerman's cart should all have tight covers for the same reason. In addition, each transfer pump, oil container, gun-loader pump, grease gun, etc., should be marked for and used with one product only so as to prevent mixing lubricants of different types. Mixing can be a harmful form of contamination.

Other phases of a lubrication program that should be studied and fitted to each plant are (1) purification of oils and (2) lubrication records. With regard to purification, circulation and hydraulic oils should be kept as clean as possible while in the machine. When the oils are finally drained, they should be purified and reused if it is economical to do so.

Lubrication records are necessary in connection with purchasing, storing, dispensing, applying, and purifying lubricants. They should, of course, show the cost of lubrication, but together with maintenance and production records, they should also show the profits that are made through good lubrication as compared to ordinary lubrication. The savings made by avoiding one emergency shutdown of an automated production machine might very well pay the entire lubrication bill for a long period.

Inspection Is Important

As mentioned before, the use of centralized-lubrication systems, which is quite general on automated machines, has greatly reduced the work of lubrication. Instead of hundreds of points to lubricate by oil can or grease gun, the oilerman may have a few centralized-system reservoirs to fill. He may have some manual pumping of lubricators to do, but in many cases, the pumps are motor driven and are operated by automatic cycle controllers or by pushbutton. This situation presents a fine opportunity for improving the preventive-maintenance effort in a plant: The oilerman's free time can be used for the regular inspection of lubrication and hydraulic systems.

To be of greatest value as an inspector, the oilerman should be of the type that was described before as "high-grade, well trained." Best results are obtained in plants where the pay scale

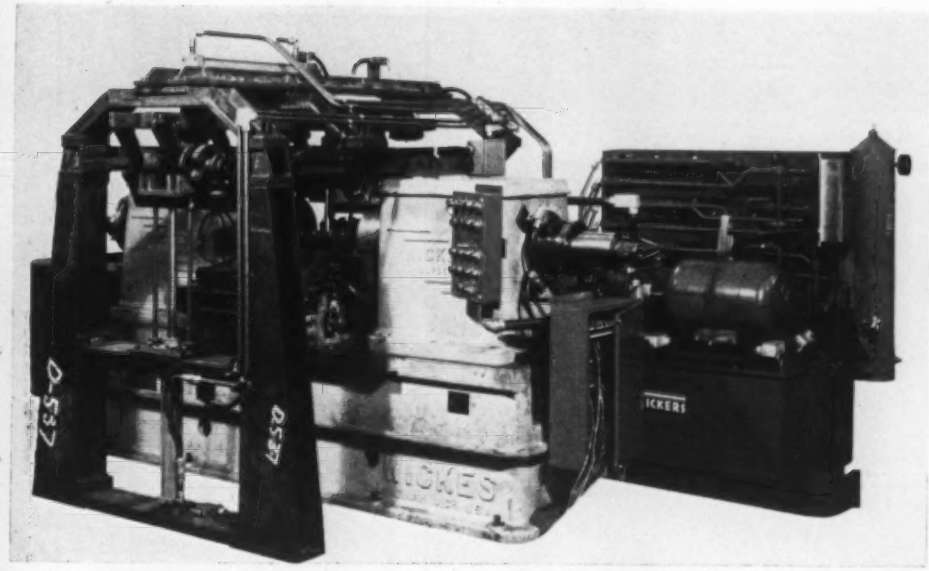


Fig. 5—Accessibility of hydraulic power units is evidenced by Vickers unit shown beside special Wickes double-end drive lathe. Hydraulic unit actuates centering type chucks and automatic handling device which straddles the machine tool.

makes the oilerman's job attractive to a man of the capability of a machine-maintenance man, machinist, or millwright. Such a man will have the necessary mechanical aptitude to understand whether or not the systems in his care are operating properly and what may happen if some faulty condition is not corrected. A few examples of items requiring inspection follow:

1. All systems should be watched for leakage, since leakage is wasteful and also may create hazardous conditions. In addition, if oil or grease gets on work pieces, costly cleaning operations may be required to remove it.

2. Centralized systems should be inspected to see that lubricant—not too much or too little—is actually reaching each bearing, gear, or desired point. Various things can happen to change the amount of lubricant reaching lubricated points even though indicators (if any) show that a system is working properly: Wear can change clearances, permitting greater flow; tubes can be flattened; fittings can shake loose; filters can become clogged; pump plungers, packings, or piston leather can become worn. With automatic systems, it is necessary from time to time to check cycle time, rate of pressure build-up, and maximum pressure since air, dirt, and soap deposits can upset performance.

3. Circulation systems should be inspected for oil temperature. Above normal temperatures are harmful and require early steps for correction. In many instances, inspection need be no more than placing the hand on a bearing housing, gear case, or hydraulic reservoir, to feel how hot it is. Repeated inspection is necessary to make sure that cover plates, breather filters, fill-hole caps—things designed to keep dirt out of reservoirs—are in place. Premium-quality circulation and hydraulic oils will last indefinitely if they can be kept clean.

From the examples given of simple, practical inspection work, it is apparent that an oilerman of the high-caliber type can easily be taught how to be a good inspector while he is carrying out his regular lubrication assignments. Training is required and this should be given by a qualified lubrication engineer. It is often reported that training raises oilerman morale. When trained to do inspection work, they become active proponents of preventive maintenance.

Inspection of lubrication systems is an important part of the lubrication program. By this means, the maintenance organization can be alerted to troubles before they become serious enough to interrupt production. Inspection triggers maintenance, and high-quality lubricants can perform their best in systems that are well maintained.

In summary, from the lubrication point of view, there is not much difference between automated machines and individual high-production machines. The lubricated parts are the same or similar. Loads, speeds, and temperatures are no more difficult. The same centralized and circulation lubrication systems are used. The major difference is expressed by saying that with automation *there is a greater premium on reliability*.

The machines and lubrication systems are good. Reliability of lubrication can be increased (1) by using high-performance lubricants, (2) by realizing that lubrication systems require maintenance, and (3) by providing a lubrication group within the preventive-maintenance department that can both service and inspect lubrication systems. The lubricant supplier should not only be able to supply the high-quality lubricants required, but also should be able to assist in every phase of setting up the lubrication program, including the training of lubrication personnel, and the evaluation of lubrication results.

In its simplest terms, lubrication in the automated plant is a matter of doing better what we already know how to do.

Fig. 1—Cases roll down storage conveyors from left to escapements which automatically release selected orders to belt conveyors. The operator at the control console sets up the selections and observes the whole operation.

AUTOMATED ORDER PICKING

SELECTS CASES FROM STORAGE

AS OUR ECONOMY has expanded, the problem of efficiently handling and distributing increased volumes of products has received much consideration. Facilities to receive quantity shipments from production operations and pick out and ship mixed orders to merchants have received much of this attention. An example of developments in this area is the warehouse system built for Gallo Sales Co. by Mathews Conveyer Co., *Fig.* 1.

In this system, cases of wine are fed by banks of roller conveyors to escapements which are remotely controlled from an operator's desk. The operator positions switches to select the type of product and the number of cases to be released, and the control system automatically releases and counts the cases. Power conveyors collect the cases and deliver them to a palletizing operation. Orders averaging approximately 8 cases each are being picked at the rate of about 125 orders per hour. The system is loaded by a crew of men who take cases from pallets and put them on the upper ends of the storage conveyors.

This automatic order filling system uses 66 gravity roller conveyors arranged in three banks, one above another. About 5000 feet of conveyors are used, and approximately 4000 cases can be stored. Each roller conveyor line has its own escapement which is solenoid actuated, *Fig.* 2, and a wheel conveyor frog, *Fig.* 3, which will roll released cases onto a conveyor belt traveling past the ends of the roller conveyors. Each bank of conveyors has a photoelectric system to count cases as they are released to the belt conveyor for that bank. The belt conveyors from the three banks run to a common horizontal plane where a powered roller conveyor setup converges the cases into a single delivery line, *Fig.* 4.

An order to be filled is set up on the control panel by operating product select switches and count select switches. When the operator has set the switches for an order, he starts the releasing actions by pressing a button on the panel. The system automatically releases and counts cases in a controlled sequence to prevent interference. Provision is made to correct errors in setting up a

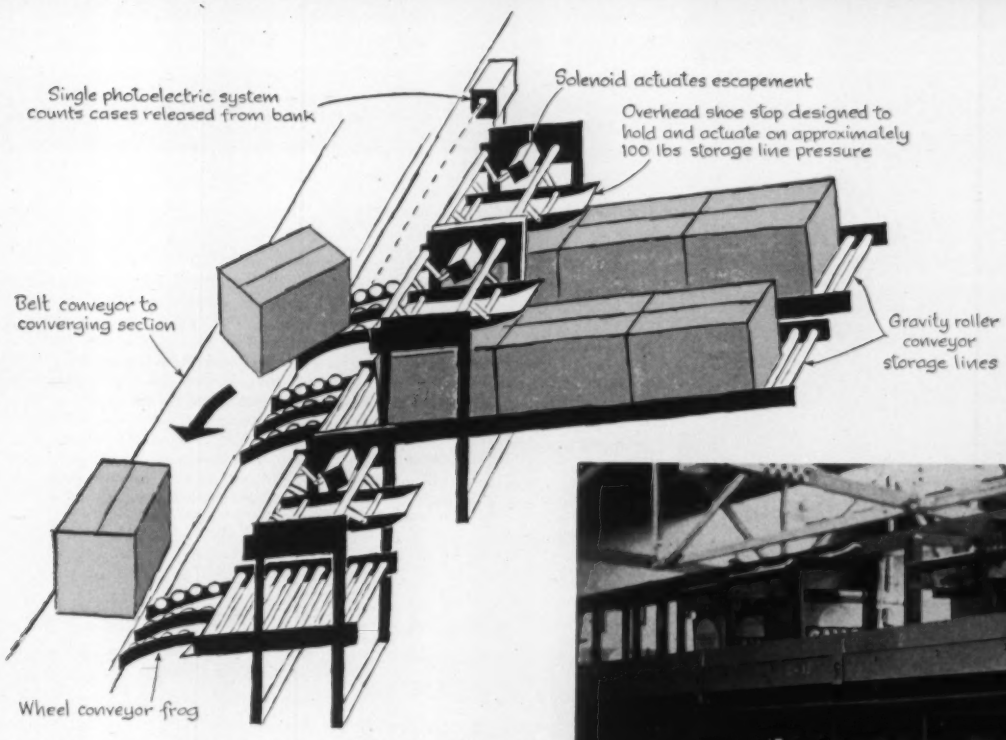

Single photoelectric system counts cases released from bank
Solenoid actuates escapement
Overhead shoe stop designed to hold and actuate on approximately 100 lbs storage line pressure
Belt conveyor to converging section
Gravity roller conveyor storage lines
Wheel conveyor frog

Fig. 2—Sketch illustrates main parts of a bank of roller conveyor storage lines feeding a single belt conveyor. In this installation three such banks are used, one above another. Solenoid actuated escapements control the release of cases from the storage lines, and a photoelectric system counts the cases released.

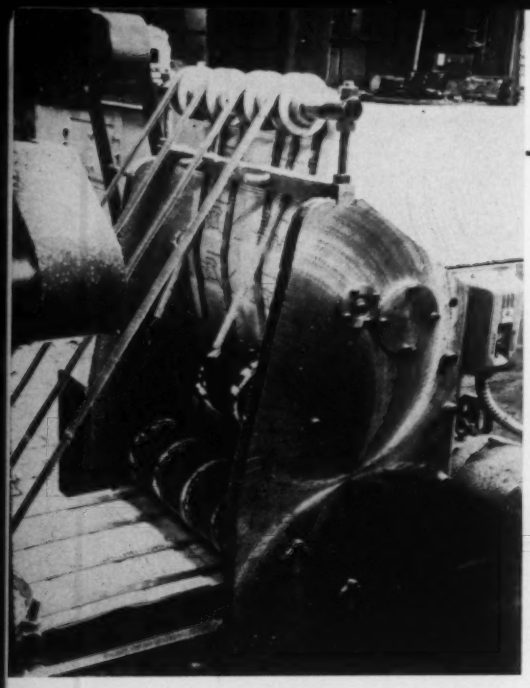
count and to clear individual release counts when a line is empty. Selector switches allow changeover between several lines for a single commodity with no resetting required in the count circuit.

Output of the system depends upon the size of the orders processed, since there is a delay provided between orders so that the system will clear itself of one order before starting on the next. This delay is used so that orders will not be intermixed. A theoretical maximum output based on one huge order would be 7200 cases per hour, which would be more than the converging system could handle. A theoretical minimum based on continuous filling of single case orders, with that one case coming from the most distant storage conveyor, would amount to one case every 15 seconds, or 240 cases per hour.

In this installation, provision is also made for manual picking of commodities which are used in small quantities. The system was designed so that commodities having a demand of less than 5 cases per day could be stored near the control panel. When such a commodity is ordered, the operator places it manually on one of the belt conveyors.

Fig. 3—When a case is released from a storage conveyor it rolls across a skate wheel frog that turns the case onto a conveyor belt running past the ends of the storage conveyors.

Fig. 4—Cases traveling on the three belt conveyors are converged into a single line by this powered roller conveyor arrangement.

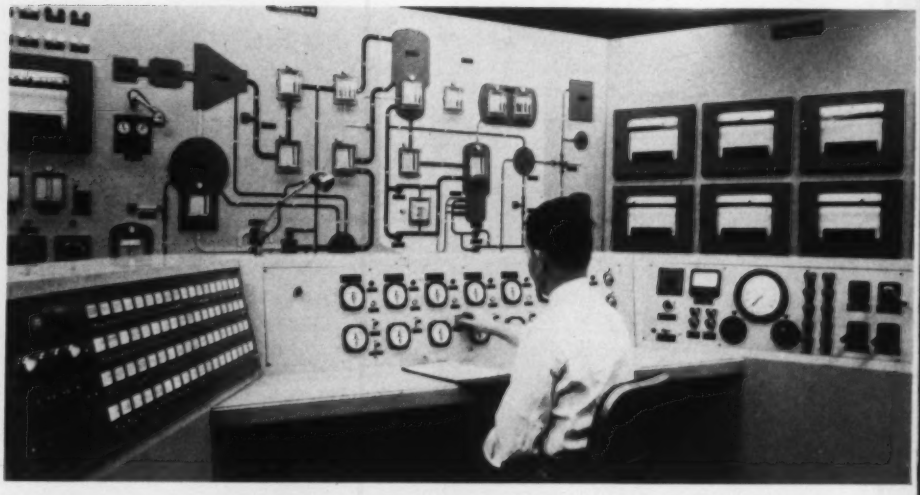


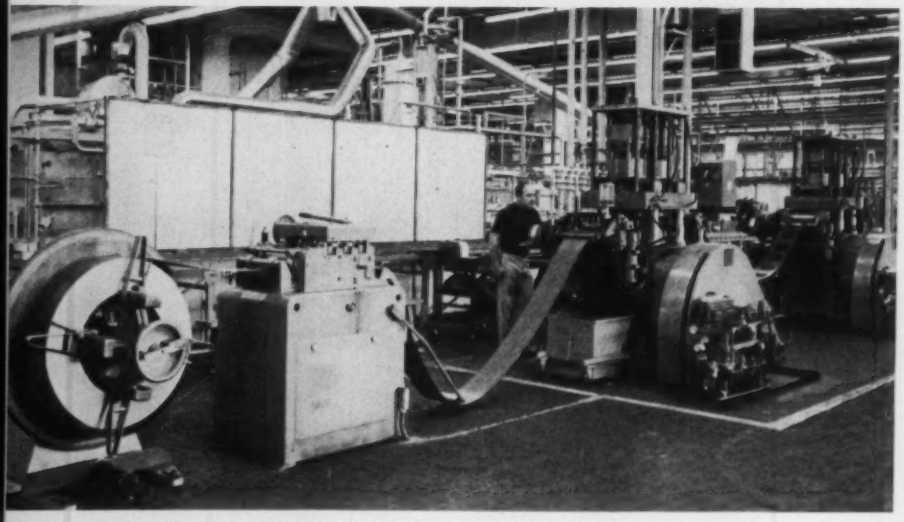
Press Bundler

BUNDLING the product stream from a printing press can require that the material be brought from horizontal to a vertical position. Equipment developed by A. R. Strobb & Son receives product from a press, and by means of vertical moving belts, raises it to where slow moving horizontal belts running on a table take over. The table includes a compressing device which holds desired amount of the product while it is being tied into a bundle. The feed from the press to the bundling table is continuous, and is independent of the press speed. This permits adjustment of feed rate to meet varying requirements imposed by different types of stock and various numbers of pages.

Reactor Control

CONTROL ROOM of the Army Package Power Reactor permits continuous monitoring of system variables. Supplied by the Industrial Div. of Minneapolis-Honeywell Regulator Co. to the prime contractor, ALCO Products Inc., the instrumentation equipment is designed to control the reaction so that power and rate-of-change of power do not exceed safe levels. The operator can check each component in the reactor system, and a 72-station annunciator pinpoints any trouble spots. Interlocks provide that the control automatically takes over when potentially dangerous situations start to develop.

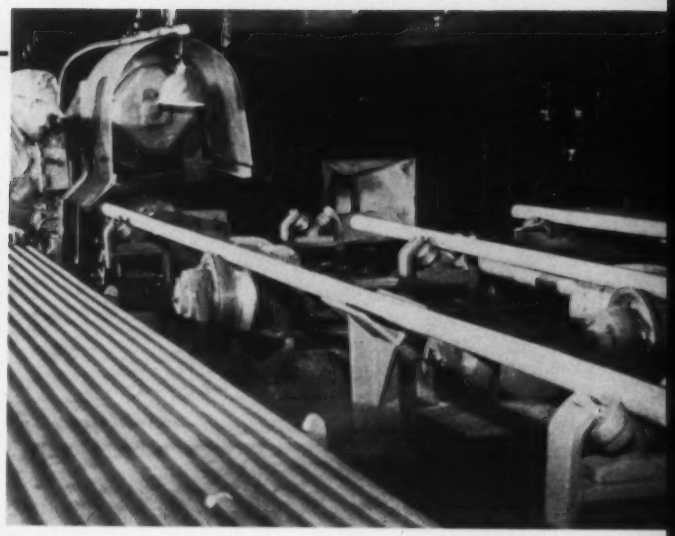




Lamination Stamping

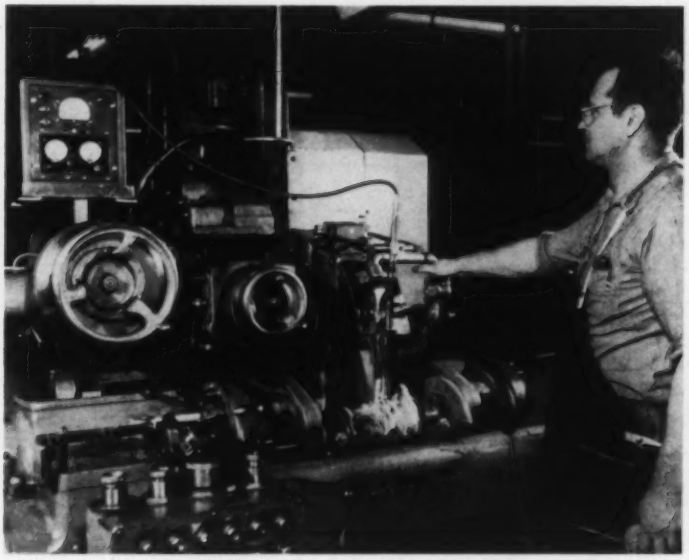
QUANTITY LAMINATION production at a new plant of Reliance Electric & Engineering Co. is based upon coil feed of stock. With the use of two 150-ton presses in series, Reliance is able to produce both stator and rotor laminations from a common coil, in a once-through, continuous operation. The metal strip is fed through a straightener into the first press where the rotor "cookie" is punched out and then to the second press where the stator "donut" is punched. Scrap from both machines is serviced by a common conveyor and is automatically carried out of the plant. The presses are synchronized by electrical means and are capable of a wide range of speeds to take care of the various designs of laminations and types of material processed.

in action



Magnetic Rolls

MAGNETIC CONVEYOR rolls installed on three pipe-facing machines at the Benwood Works of Wheeling Steel Corp. are used to feed pipe through the facing operation. Previously 25 motor-driven rolls were used for the same purpose. With motor requirements reduced to only six needed to drive the Eriez Mfg. Co. permanent magnetic rolls, maintenance requirements for motors have been considerably reduced. Magnetic rolls eliminate bounce and slippage of pipe during feeding operation and are a factor in reducing the potential hazard associated with any manual handling operations. Pipe, in 20-foot lengths, is conveyed between machines at the rate of 2000 pieces per hour.



Building Blocks

SMALL QUANTITY producers interested in automating machining or inspection operations must depend upon inexpensive and versatile equipment. Airborne Instruments Laboratory Inc. has developed a line of automation equipment which performs such functions as gaging and feedback control, depending on the user to provide mechanical portions required in a given setup. For example, automobile crankshaft grinding at Cadillac Motor Co. has been equipped with units that provide a system of control based upon continuous measurement of work size. Upon near approach to desired size, the control slows machine feed and automatically stops the grinder when the desired size is reached. In addition to this type of control, the basic equipment units can be combined to control sorting of parts by size or keep track of part sizes for statistical control purposes.

Truck Conveyor

IN-FLOOR CONVEYOR at International Harvester Co.'s Chicago Tractor Works forms an integral part of an assembly line that carries bulldozer and grader parts through finishing operations to outside storage. The in-floor conveyor is particularly suited to handling large and bulky parts. During the finishing operations, the conveyor is subjected to high heat in a drying tunnel and in the storage yard, can be exposed to sub-zero weather. The outdoor track section is equipped with a steam pipe below the chain to keep the chain trough free of snow and ice. The Link-Belt Co. Truckveyor can be used at motor freight docks, freight terminals, warehouses, and at locations where similar handling problems are encountered.

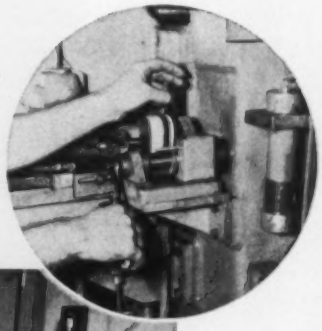
VERSATILE TRANSFER MACHINE PROCESSES VARIETY OF PARTS

FROM the experience of Reliance Electric and Engineering Co. with a new transfer line, considerable weight has been added to the argument that the use of in-line transfer machines is not limited to high quantity production requirements. As part of a new plant addition to their Ashtabula operations, the company has installed a 12-station transfer machine for facing, boring, milling, drilling, and tapping operations on motor frames. With the exception of a rabbeting operation, all machining operations on cast motor frames are completed automatically at production rates varying from 42 to 70 frames per hour. By properly planning the sequence of frame types and sizes to be produced, as few as 40 frames per lot can be economically handled by the machine.

Variation in production rates depends on the frame being machined, as the transfer machine includes features which allow its use for 36 different part numbers. Variety of frames encompasses three motor diameters—each includes two different lengths, is either vertical or foot-mounted, and is provided with protected-open, totally-enclosed, or explosion-proof enclosures.

In order to simplify setup variations, each work transfer shuttle contains three different size fixtures for the three diameters involved; for a frame size change, the stroke of the shuttle is adjusted. Changes in tool positioning are accomplished with the aid of special accessories including colored spacers which are removed or added at each tool position to vary limit-switch dogs. Changing the machine from one length to another for the same diameter frame takes about an hour. Change-over from one enclosure to another or from a vertical to a foot-mounted style also requires about one hour, while a complete change from one diameter to another consumes nine hours. The transfer machine does the work of a milling machine, 11 vertical turret lathes, a multiple spindle drilling machine and a five-spindle drilling machine. It is estimated that the conventional machines would require as much as ten times the setup time as is needed for the transfer line.

The cost of the transfer machine was approximately 25 per cent lower than the price of the standard equipment which would accomplish the same tasks. When this saving is added to the other plus factors—savings in floor space and manpower (only three operators are used), shorter setup and change-over time, increased accuracy and uniformity in machining—it is apparent that a sound economic basis exists for the decision to use the transfer machine. The ability to process as few as 40 frames per lot is important, but of equal significance is the potential capacity of the transfer machine—capacity for the future that will not require further investment.



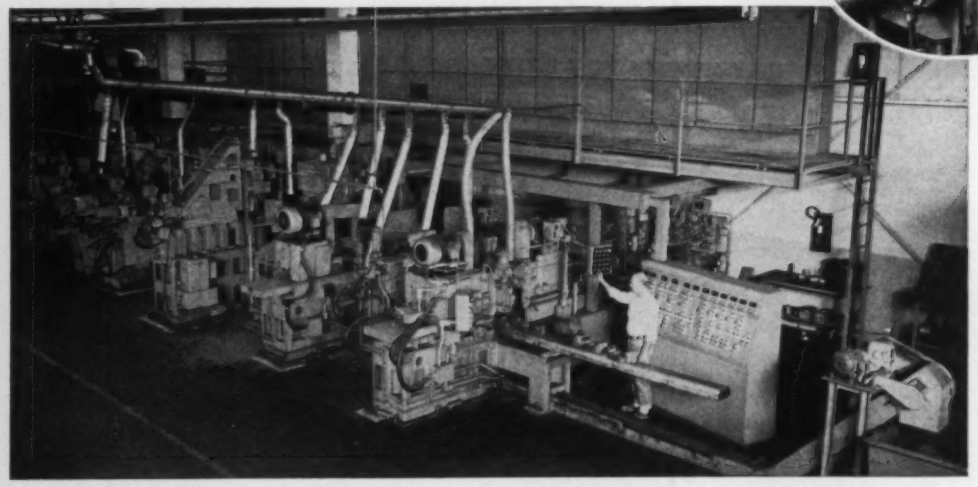


Fig. 1—Twelve-station Sundstrand transfer machine at Reliance Electric processes 36 variations of three sizes of motor frames. Change-over of tooling is speeded up by use of color coded spacers to position limit-switch dogs.

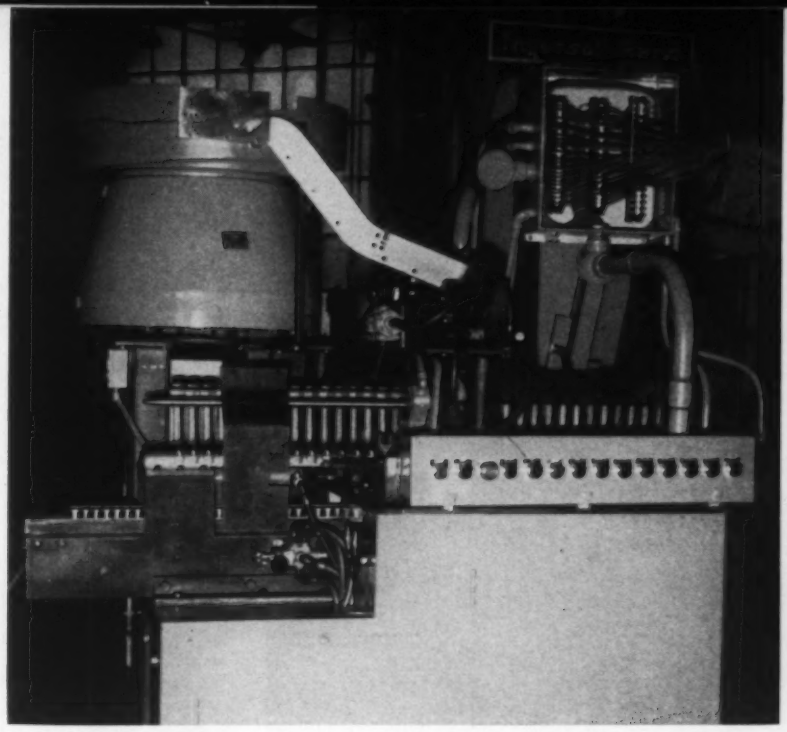
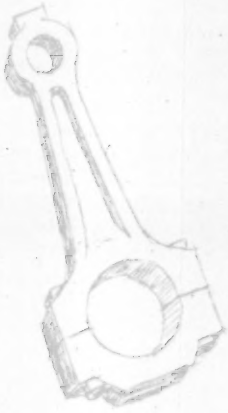


Fig. 1 — Pneumatically powered, electrically controlled assembly machine that automatically makes 700 connecting rod and cap assemblies per hour.



CONNECTING ROD ASSEMBLY

In-process assembly operations that are followed by machining operations have an inherent need for automatic assembly equipment that can keep pace with the requirements of the machining line. This article describes a machine that assembles connecting rods and caps and bolts them together prior to machining the crankpin bore.

By **RICHARD LEES**, Supervisor, Assembly Machine Section, Ingersoll-Rand, Athens, Pa.

PRODUCTION SEQUENCES for the manufacture of connecting rod assemblies usually require that the rod and cap be bolted together prior to final machining of the crankpin bore. Sizing this hole as if the rod assembly were one piece results in mating and fit conditions at final engine assembly that are more accurate than are obtainable if the rods and caps are completely machined as separate details.

To assure that reassembly of rods and caps in the engine will reproduce conditions equivalent to those obtained in precision machining, each assembly is torque-tightened to engineering specifications.

High quantity production of automobile engines has highlighted a need for automatic assembly equipment that can keep pace with the requirements of automated machining lines. Ingersoll-Rand has designed and built a machine that handles the six parts (rod, cap, two screws, and two nuts) of the connecting rod assembly, *Fig.* 1. This machine is of the straight-line transfer type and is designed to operate at the rate of 700 assemblies per hour.

Intermachine Handling

To provide for integration of an assembly machine into an automated production line consideration must be given to handling of each of the com-

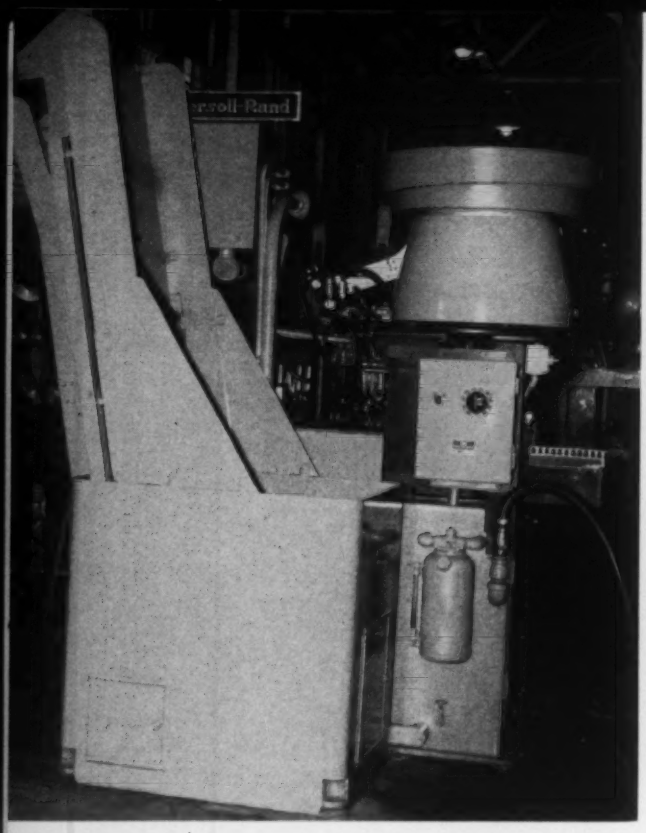


Fig. 2—Rear view of straight-line assembly machine shows relative locations of vibratory bowl feeder that handles screws and elevating feeder that handles nuts.

ponent parts from a previous operation or from storage.

This machine receives connecting rods and caps at the entry end of the line. The shank of the rod goes vertically between parallel bars of a "lift-and-carry" conveyor section. The open half-bore faces down. The caps go onto parallel bars mounted below the rod rack. The open half-bore faces up. These bars are arranged in such a manner that the parts can be delivered by chute from their previous operations or hand loaded from tote pans or trays.

Screws are received in bulk and dumped into the bowl of a Perry Equipment & Engineering Co. vibrating feeder. Nuts are also handled in bulk and dumped into the hopper of a Feedall elevating feeder, *Fig.* 2. This feeder has capacity and arrangements to supply two such assembly machines, one from each side of the feeder.

Orienting and Feeding

If hand loading of rods and caps is used the operator must orient the parts with the proper face forward. If mechanical handling from the previous operations is used, part orientation can be maintained in transit and there is no need to orient parts here. The bars of the lift-and-carry conveyor serve as magazines that provide a bank of parts ahead of a positive index transfer bar mechanism that connects the assembly stations of the machine.

As the conveyor bars lift they catch hold of each rod under the piston pin boss and thus suspend the rods as the parallel bars move forward in a walking beam motion. The bars descend and the connecting rods rest in an advanced position on a lower locator bar. The lift-and-carry motion also brings the caps forward until they are automatically engaged with the rod. Action of this section of the machine is such that parts in this magazine touch each other with no space between, *Fig.* 3.

First orientation of the screws is accomplished in the bowl track. Screws are suspended by their heads in the outlet chute. At the end of the chute an escapement device divides the flow into two paths and the screws drop into either of two orienting stations, *Figs.* 4 and 5, to be angularly positioned so that the specially contoured screw heads have the proper left and right hand relationship with the rod. Tubes of a special section that maintains this angular orientation are fitted with escapements that allow the screws to drop into the rod holes at the proper time. All escapements are synchronized with the transfer drives.

Orientation of the nuts requires that they be fed with the axis of the hole vertical (either face up). This orientation of the nut is accomplished in the track of the elevator feeder and maintained by the configuration of twin delivery tracks that go to the nutrunners at the last station of the machine, *Fig.*

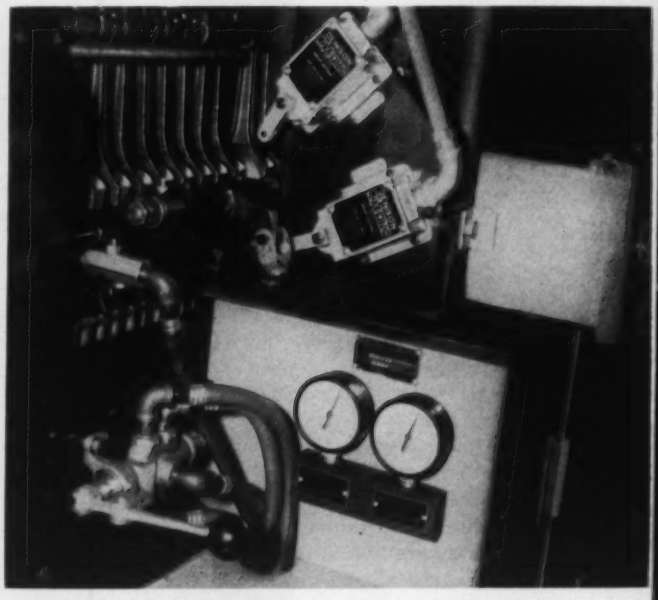


Fig. 3—Close up of lift-and-carry conveyor section that serves as a feed magazine to move both rods (above) and caps (below) into position to be moved on by the transfer bar mechanism.

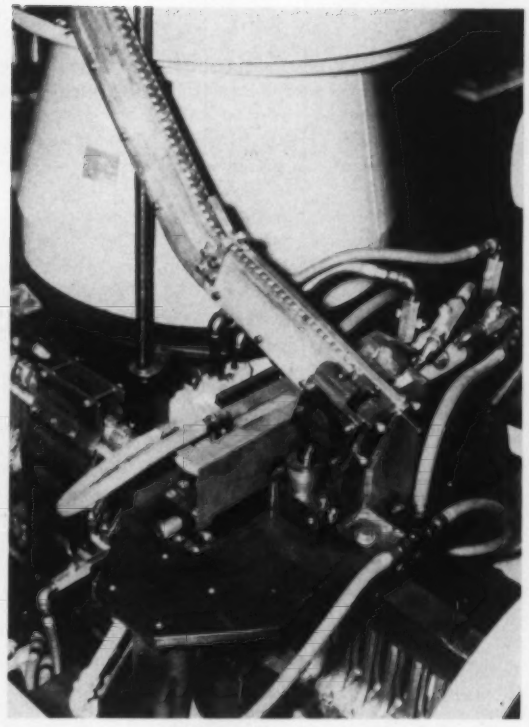


Fig. 4—Track of bowl feeder orients screws so they descend outlet chute suspended by their heads. At bottom of chute screws are divided into two paths and drop into angular orientation stations.

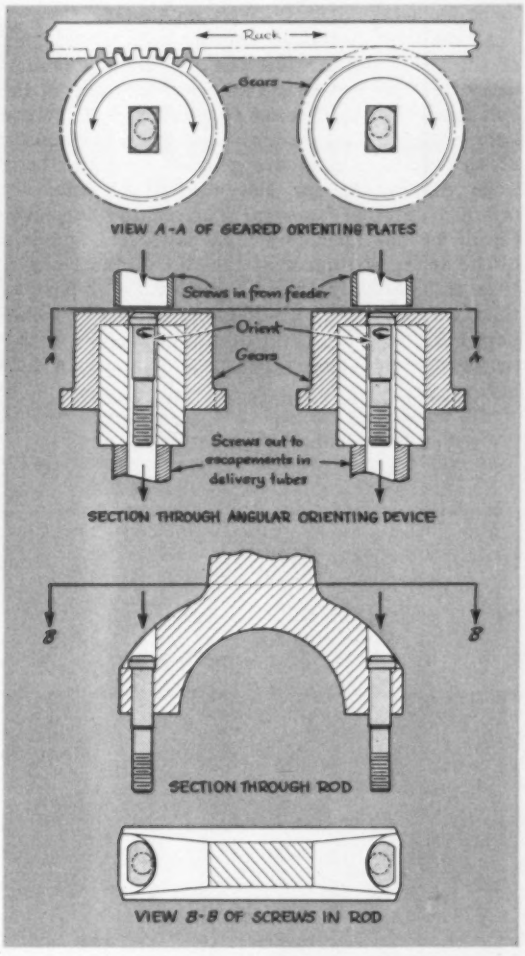


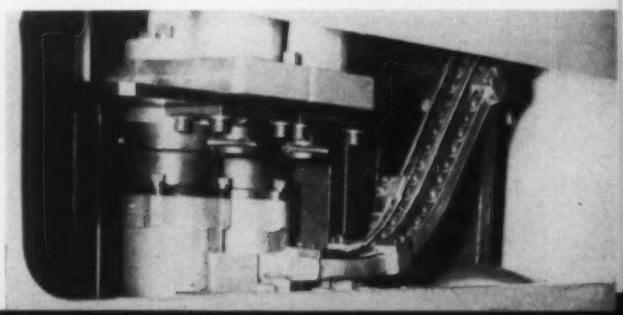
Fig. 5—Angular orientation device pictured in Fig. 4 has gears mounted below tubes from feeder chute. Off-center contours of screw heads hang up in rectangular holes in gears. Rack is oscillated by an air cylinder and causes gears to rotate back and forth through 180 degree arc. At one or the other reversal point screw heads line up with contoured blocks below and fall into delivery tubes. Screws remain in delivery tubes until synchronized action of escapements drops the oriented screws into the rods where they are pressed into place.

6. Nuts are fed upward through hollow offset spindles of the nutrunners, *Fig.* 7. At the bottom stroke of the nutrunner slide, two plungers push one nut from each track up into each spindle which has a column of nuts in it at all times. This arrangement accomplishes feeding and driving of nuts from underneath the assemblies and avoids inverting the connecting rods which would otherwise be required if the screws and nuts were both fed from the topside of the machine.

▸ Assembly Sequence

Design of the transfer bars for positive indexing of connecting rods through the assembly stations is such that equally spaced fingers project from one side of two round bars. One bar is on each side of the line and each extends the length of this section of the machine. The bars are caused to rotate about their axes and the first fingers separate a rod from the end of the group in the magazine. The transfer mechanism moves forward and at the end of its stroke the bars are rotated, disengaging the fingers. With the fingers thus withdrawn the mechanism returns the bars to their original position where they are again rotated—re-engaging the fingers with the connecting rods

Fig. 6—Nuts are delivered by twin tracks to the underneath side of two hollow, offset nutrunner spindles. Spindles are shown in their *Up* position. Rotary air motors power these spindles. Air motors stall when proper torque has been reached. Regulation of air pressure provides torque adjustment.



to be moved.

At the first station during the positive indexing of the rod, bolts are inserted and given a preliminary light press to maintain the orientation of the bolt head. At the second station bolts are forced home with a final heavy press. Simultaneously, at this station, caps are pressed over the bolts from below. At the last station the nuts are brought up from below and driven to the proper torque by the airmotors that power the spindles.

The transfer fingers at the end of the transfer bars automatically unload the machine by pushing the connecting rod assemblies off the end of a support bar. Delivery can be onto a conveyor, chute, or rack for transportation to the crankpin hole boring operation.

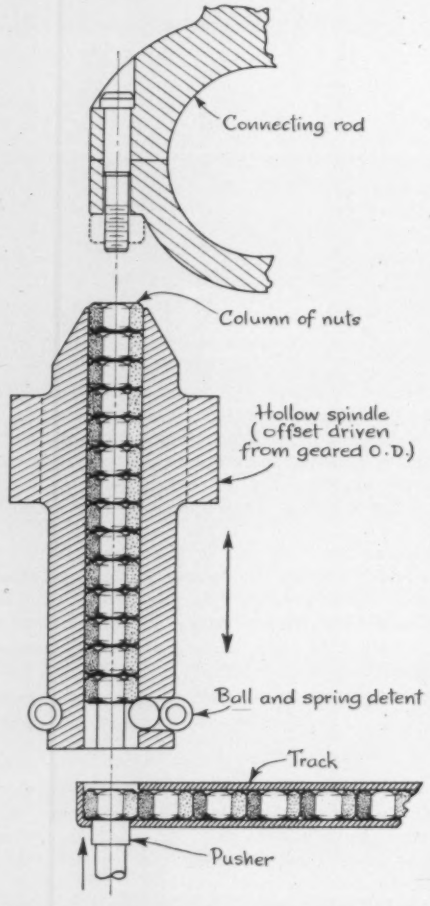


Fig. 7—Arrangement of nutrunner spindle relative to track and workpiece shows column of nuts within hollow spindle. At bottom of spindle stroke pusher delivers another nut up into rotating spindle. Ball and spring detent retains nuts in spindle. As spindle strokes upward nut engages screw.

▶ Machine Features

All mechanisms of the machine proper are pneumatically powered and electrically controlled. For ease of maintenance and to save floor space the machine has been designed as a series of subassembly units each of which can be rolled out for service, *Fig.* 8.

Interlocking controls provide for the detection of a missing screw, nut, or cap. This information is transmitted to the operator by signal lights. Simultaneously the machine is stopped and goes into manual control. The operator may then correct the condition and put the machine back into automatic control.

The tooling arrangements were designed with consideration given to contemplated product size changes. The feeding and assemb'y arrangements were adapted to this specialized application by a group of engineers whose sole specialty is machines and devices for automatic assembly of parts held together by threaded fasteners.

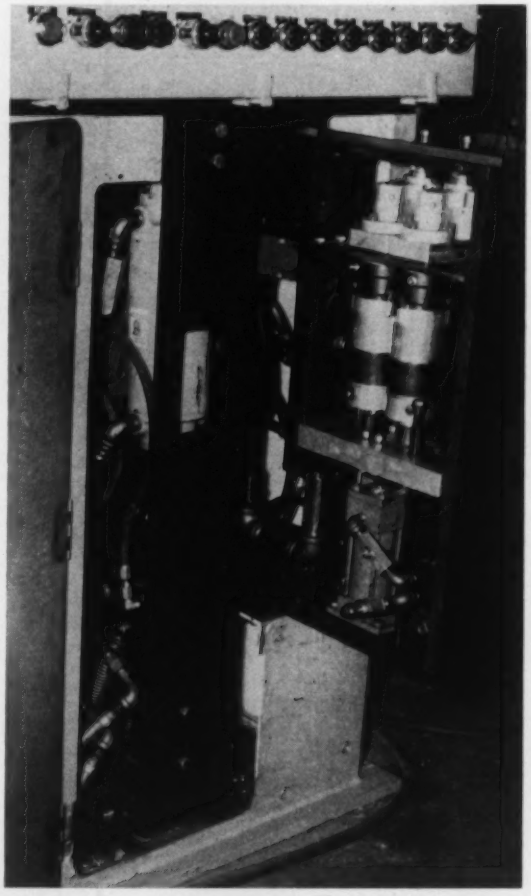
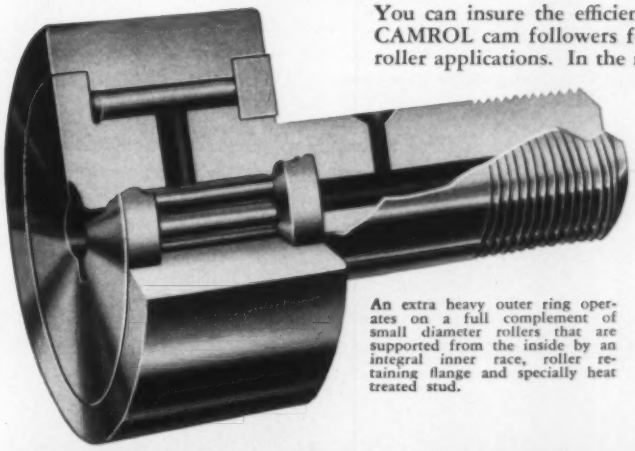


Fig. 8—Unit type construction is illustrated by view of nutrunner subassembly rolled out of machine base. Arrangement provides maintenance access yet conserves floor space.

AUTOMATION TIPS by McGill

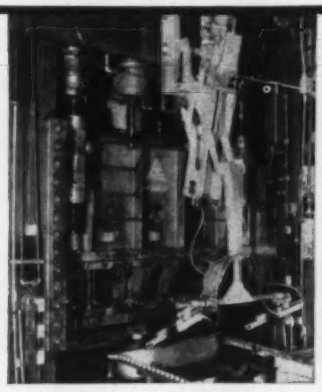
Insist on CAMROL TRADE MARK bearing advantages when planning your automation



An extra heavy outer ring operates on a full complement of small diameter rollers that are supported from the inside by an integral inner race, roller retaining flange and specially heat treated stud.

You can insure the efficiency of your automated production by specifying CAMROL cam followers for cam action, track roller or guide and support roller applications. In the machinery you specify or in your own automated operations, CAMROL bearing quality guarantees dependability and longer bearing life. Their ability to withstand intermittent shock and heavy radial loads, space economy, ease of installation, simplified lubrication and balanced hardness and toughness recommends CAMROL cam followers for the critical antifriction requirements of automation. You can eliminate downtime due to premature failures of improvised units or ordinary bearings.

Insist on CAMROL CF or CYR (without stud) bearings. Both types are available in a wide range of standard sizes as are the sealed SCF and SCYR series.



Camrol bearings eliminate bearing trouble for Sahlin iron hand unloaders.

Sealed CAMROL SCF bearings on th upper arm assembly travel a confined ca track to provide direction and support fo the unloading arm. Here the IRON HAND machine is shown removing 12 lb. bathtub blanks from a forming pre onto a conveyor for additional automati operations. The Sahlin Engineering Co Inc. that supplies this unique press un loader to automate press operation adopting CAMROL cam followers, ha virtually eliminated bearing replacemen under all conditions.

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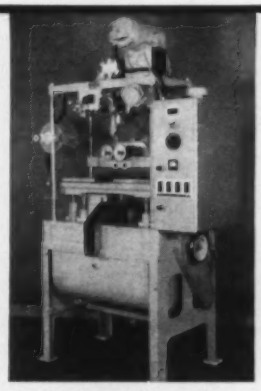

Camrol bearings show no apparent wear after three years use in automatic packaging machines.

The Kartridg-Pak Machine Co. uses McGill CAMROL bearings in the main drive mechanism of a packaging machine that also forms the container from thermoplastic film. This machine automatically forms, fills and closes 1800 packages of food or other semi-fluid products per hour. Dependability and accuracy of the free rolling and easily lubricated cam followers help guarantee the efficiency of these automatic operations.

After three years of use in this application, the CAMROL bearings show no apparent wear.

Camrol bearings assure greater speed and accuracy in shear-speed shapers.

Michigan Tool Co. uses CAMROL CF and CYR bearings in Shear-Speed Shapers that automatically produce gears up to 20 inches in diameter and up to 6 inch widths in only 13 minutes. These bearings, acting as cam followers, accurately control the feed of all cutting tools simultaneously and relieve these tools from the work on return strokes. They insure dependable, precision performance for automatic operations at high production speeds in these largest production gear cutting machines ever built.

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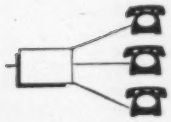
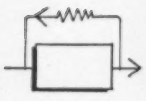
Certain discoveries, inventions and developments of Bell Telephone Laboratories have been truly epochal in their effect upon the technology of our time. Each has come out of a single quest—a search for ways to make telephony ever better. But many have opened the way to exciting advances in TV, movies, radio, horology, astronomy. Here are ten of Bell Laboratories' contributions to the modern world.

Electronic amplifier. First high-vacuum electronic amplifier. Made possible long distance telephony and then opened the way to radio broadcasting.



Wave filter. Precisely separates bands of frequencies. Provided major key to economical sharing of the same wires by many voices or radio programs. Indispensable control tool in radio, television and radar.



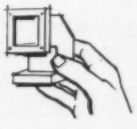
Negative feedback amplifier. Provides distortionless and stable amplification. Made possible the enormous, precisely controlled amplification needed in long distance telephone calls. The principle is now basic in high-quality amplifiers for radio, TV and high-fidelity reproduction.

Quartz crystal. Standard super-accurate quartz crystal oscillator developed for frequency controls in radio telephony. Has also become the standard control for clocks in world's astronomical laboratories.

Coaxial cable system. Hollow tube with a central conductor was developed to transmit hundreds of voices simultaneously. Now also provides long distance carrier for TV in partnership with microwave beams.

Transistor. Tiny solid-state device uses extremely small amounts of power to amplify signals. Makes possible electronic telephone switching and much smaller hearing aids, radios, TV sets and electronic computers.

Dial system "brain and memory." Takes over your call and sees that you are connected in the best and quickest way. Newest example: Direct Distance Dialing from home telephones to any part of the nation.



Waveguide. Hollow conductor transmits high-frequency waves. From this came the "pipe" circuits that are essential to radar and very short-wave radio communications.

Microwaves. Bell Laboratories developed long distance microwave transmission. It operates by focusing radio beams from station to station, carries cross-country telephony and TV.

Radio astronomy. This great new science began in the study of radio interference at Bell Laboratories . . . with the tremendous discovery that radio waves emanate from the stars.

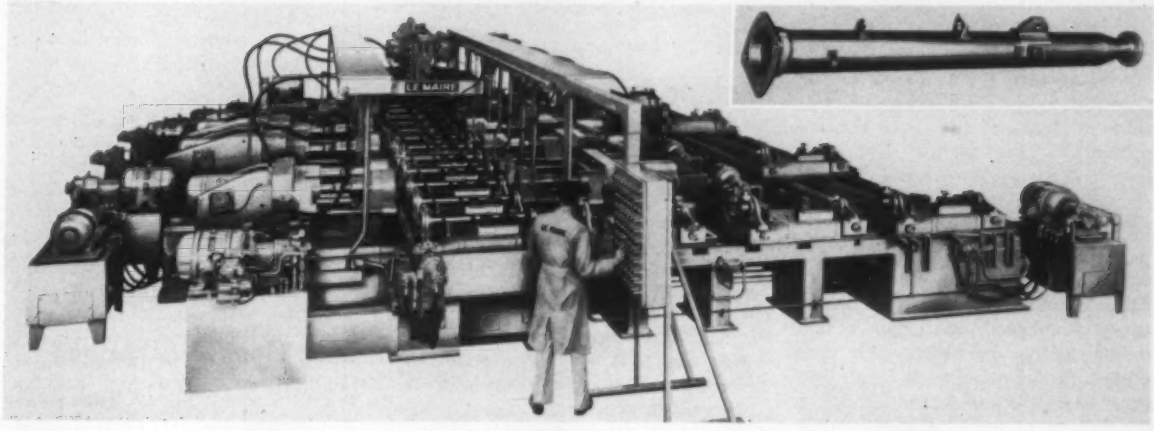
BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

AUTOMATION new equipment

Machines and plant equipment designed for more automatic operations

For detailed information and literature, use card page 17



Torque Tubes Automatically Machined

A 14-station transfer unit built to completely machine two different length torque tubes with a minimum of set-up time for changing over from one size to the other, has been designed by **LeMaire Tool & Manufacturing Co.**, 2657 South Telegraph Rd., Dearborn, Mich. Developed with unitized construction, the machine has idle stations arranged to allow ample room between working stations for easy accessibility. The torque tube is loaded manually into the fixture at the load station and clamped automatically by two equalizing chuck jaws, actuated by two hydraulic power wrenches. As loaded fixtures move through the machine, they are located in each working station by shot bolts which enter bushings in the bottom of the fixture. As the shot bolts enter the fixture, the fixture is clamped automatically on a hardened rest plate. As the work heads move forward, plugging bars locate into the fixture, assuring positive alignment of the fixtures and the heads.

Torque Wrench

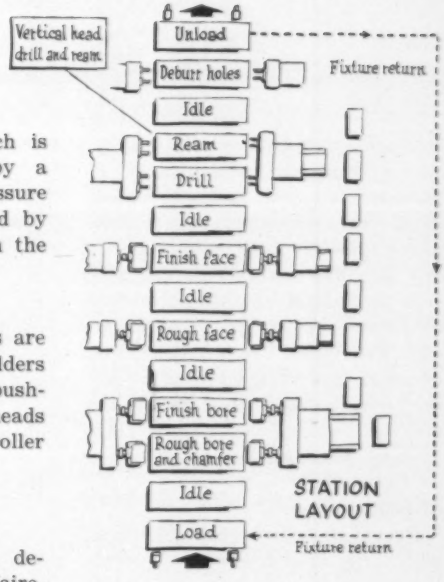
The LeMaire torque wrench is a compact unit operated by a fluid motor. Clamping pressure can be increased or decreased by adjusting a pressure valve on the hydraulic unit.

Tooling

The boring and facing tools are held in anti-friction tool holders supported by Ampco bronze bushings. Boring and facing heads are designed with tapered roller bearing construction.

Fixture Shuttle and Return Conveyor

A shuttle bar conveyor, designed and built by LeMaire, transfers the empty fixtures to the long fixture return conveyor. Two decelerating valves are necessary; one with the shuttle bar which controls the fixture's speed as it moves into position on the long conveyor section, which has the other valve. The long conveyor returns the fixture to the front end of the machine by means of a chain and sprocket, driven by a fluid motor through a speed reducer. The empty fixture is picked up at the front of the machine by a second shuttle bar conveyor, which places the fixture in the load station to repeat the cycle.



Hydraulic Equipment

Vickers double pumps are used on hydraulic tank units, and the reservoirs are at least 3 to 1 ratio to pump capacity. Heavy walled

seamless steel tubing is used. Vickers valves are mounted on manifolds.

Electrical Equipment

The machine is completely electrically interlocked. Limit switches are arranged outside of the machine bases for easy access and to keep them out of the coolant area. All limit swithes are wired back to the control panel. Individual pushbuttons are provided at each station.

Two overhead duct lengths with terminal strips inside are the junction point between the machine wiring and the three control cabinets. Long-lasting hydraulic hose and fittings are used for the electrical flexible hose on this machine.

Three control cabinets are equipped with Spaulding Fibre duct. Terminal strips are consecutively numbered, with joiner terminal strips between each sub plate. Each cabinet is equipped with inside fluorescent lights. A ground detector light indicates when a ground occurs in the machine.

Test Panel

A test panel consisting of a voltmeter, continuity test lamp, test prongs and phono jacks, is provided for each control cabinet. With the voltmeter, a maintenance man can test voltage across any outgoing wire to the machine.

A microfilm of the electrical schematic sketch is provided at each test panel. It is mounted on plywood and sprayed with a protective material so that grease and dirt can be removed with a cloth without marking the print.

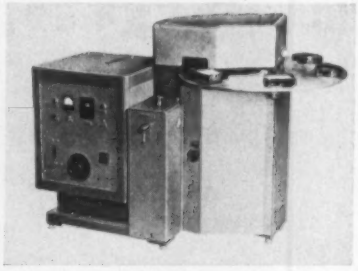
Chip Conveyor

Provided with a May-Fran dual floor type chip conveyor, machine bases are designed with chip slopes, allowing chips to fall directly into the chip conveyor below. Chips are taken to the end of the machine, where a second conveyor carries them into a chip tote cart.

Coolant System

A coolant system is installed in the floor beneath the machine. One 400-gallon pump supplies ample coolant for cutting tools and for flushing chips from the fixtures.

—*Circle 401



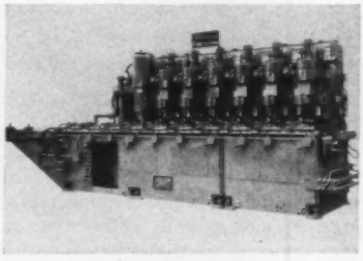
Bubble Sealer

Item 402—

Machine designed for high-speed show case packaging of small merchandise. A transparent, plastic bubble bonded to a display card effectively presents hardware, soft goods and granular products for complete visibility.

Automatic bubble sealer is 4 ft wide and 6 ft long. The dielectric heating speed can be adjusted to produce from 5 to 20 sealed packages per minute. Package sizes can be changed in 3 minutes. Unit operates on 220v, 60 cycle, one phase power. **Erdco Engineering Corp.**, Addison, Ill.

—*Circle 402



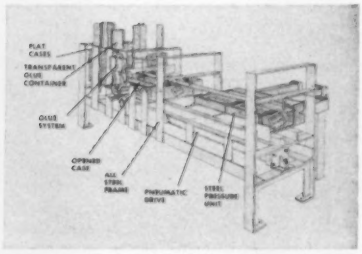
Processing Pistons

Item 403—

Eleven-station in-line transfer machine automatically performs nine drilling, reaming and milling operations on automotive pistons. The pistons are delivered dome side down to the first station by a conveyor where they are automatically accepted and loaded into the machine. Station-to-station transfer is accomplished by hydraulically operated transfer fingers and a reciprocating transfer bar.

At the following stations, orientation; center dome drilling and spotfacing; weight pad milling, spot drilling and reaming; pin boss drilling; and dumping of chips and coolant are performed. At the final station the part is automatically unloaded to a conveyor. The machine is capable of automatically machining 650 pistons per hour at 100 per cent efficiency. **Motch & Merryweather Machinery Co.**, 888 E. 70th St., Cleveland, O.

—*Circle 403



Case Opener & Former

Item 404—

Automatic packaging is afforded by Formnumatic case opening and forming machine. The unit automatically selects a flat case from the magazine in the end of the machine, advances the case, applies glue, opens and forms, folds in the bottom flaps and seals. The glueing mechanism may be omitted if the machine is to be used as a case opener and former alone.

The packaging unit is pneumatically driven, with a minimum of moving parts. For a case 16 by 11 by 5-inches the compact machine is 9 ft long, overall, and approximately 22 inches wide, allowing multiple units to be placed in parallel arrangement. This provides unlimited speeds and makes it possible to open and form cases of various sizes simultaneously. Machines are custom built to case size. **Schroeder Machines Corp.**, P. O. Box 1123, Syracuse 1, N.Y.

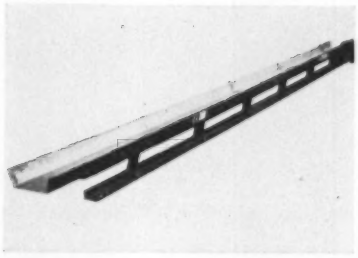
—*Circle 404

Light-Duty Conveyor

Item 405—

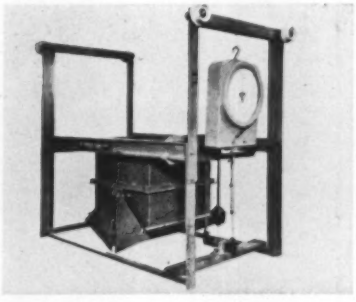
Designed to handle a variety of light bulk materials, Model 36 has a 4-inch deep pan which is supported on steel rocker arms and

*For Inquiry Card, see page 17



steel-encased rubber bushings. Oscillating action is provided by a motor-driven eccentric shaft and steel connecting arm attached to the conveyor pan by two steel-encased rubber bushings. The eccentric shaft is mounted on the main frame by two precision, self-aligning ball bearing pillow blocks.

Conveyor sections are stocked in lengths of 5 and 10 ft with a choice of 4, 6 and 8-inch wide pans in 14-gage mild steel; 10 and 12-inch wide pans in 12 gage steel. Sections can be assembled to a length of 50 ft with one drive assembly. **Simplicity Engineering Co.**, Durand, Mich.
—*Circle 405



Portable Scale

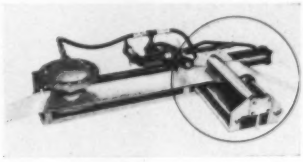
Item 406—

Capable of handling loads from 200 to 1000 lb, Model J-50 is developed for weighing heavy bulk materials at storage bins located at scattered points within a plant.

For simple weighing, the scale is wheeled to a storage bin loaded with an amount of material. It then moves to the processing equipment, where the scale contents are discharged through clamshell gates. Discharge may be by hand lever or air cylinder.

In weight proportioning operations, the scale is wheeled from bin to bin and desired amounts of material cumulatively weighed, one batch at a time. A large springdial is provided so that the scale operator can keep an accurate check on individual weighings. An accuracy within 1¼ lb per 1000 lb weighings is possible.

The portable scale may be specified for mounting on overhead tracks and is also available with a tank weigh hopper, for liquid weighing operations. **Richardson Scale Co.**, Van Houten Ave., Clifton, N. J.
—*Circle 406



Stock Leveler

Item 407—

Designed for use with equipment which is powerful enough to pull coiled stock through the straightening rolls, the Ses-Matic coiled stock leveler removes coil curvature from stock up to 12 in. wide by 0.090 in. thick or 18 in. wide by 0.06 in. thick.

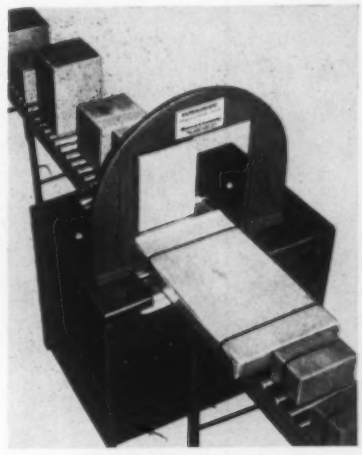
Built with three smooth finished rolls mounted on roller bearings, the unit is adjustable to provide a means of controlling the degree of flexing the stock. **Special Engineering Service Inc.**, 8161 Livernois Ave., Detroit 4, Mich.
—*Circle 407

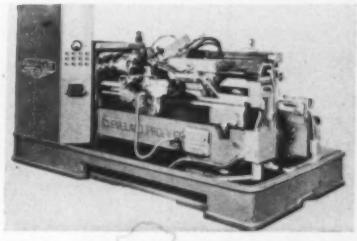
Automatic Binder

Item 408—

Designed for use on high speed, continuous-flow packaging operations, the Autobinder automatically tensions, seals, and cuts straps on packages up to 20½-inches wide and 22½-inches high. Machine straps different size packages without adjustment or an operator. It can be set to perform semiautomatically if hand operations, such as jogging contents of carton or folding flaps, are required on the line.

An electrically powered strap dispenser—limit switch controlled to feed strap uniformly into the machine is included. **A. J. Gerrard & Co.**, 1950 Hawthorne Ave., Melrose Park, Ill.
—*Circle 408





Profile Lathe

Item 409—

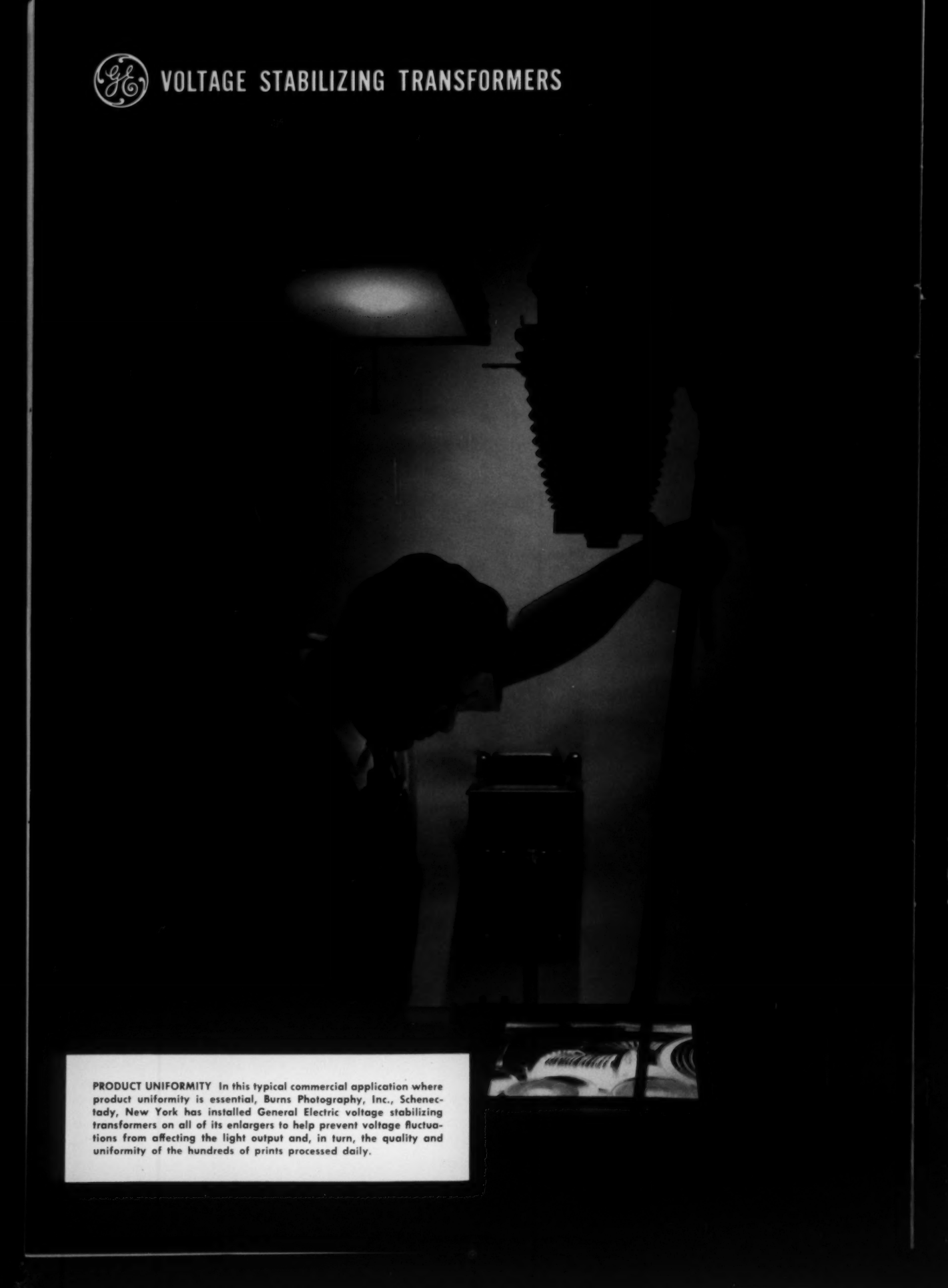
Designed for use by semi-skilled operators the hydraulically actuated profile lathe has a heavy cast construction, permitting full utilization of the advantages of carbide and ceramic tools, allowing spindle speeds to 5000 rpm and motors to 50 hp.

The lathe duplicates from flat or round templates, or from the sample part. Quick, easy sequence control settings are made on a panel of adjustable stops mounted on the front of the machine. Profiling is obtained by use of a balanced, spool, hydraulic tracing stylus requiring a force of less then ten ounces. The slide is hydraulically actuated and cycles automatically. It can take up to four automatic recycle passes at

*For Inquiry Card, see page 17

Next Page Circle 738→

VOLTAGE STABILIZING TRANSFORMERS



PRODUCT UNIFORMITY In this typical commercial application where product uniformity is essential, Burns Photography, Inc., Schenectady, New York has installed General Electric voltage stabilizing transformers on all of its enlargers to help prevent voltage fluctuations from affecting the light output and, in turn, the quality and uniformity of the hundreds of prints processed daily.

Here's why General Electric voltage stabilizing transformers help assure . . .

- **PRODUCT UNIFORMITY**
- **PRODUCT DEPENDABILITY**
- **PRODUCTION CYCLE CONTINUITY**

General Electric voltage stabilizing transformers are factory adjusted to stabilize output voltage to within ±1% in less than two cycles. Even if line voltage fluctuates by as much as 75%, the rapid response of these G-E units helps prevent voltage fluctuations from even momentarily affecting the performance of most equipment. Further, G-E voltage stabilizing transformers are completely automatic – no adjustments are needed; no moving parts, relays, or tubes are present to cause maintenance problems.

These are just a few of the reasons why you can rely on G-E voltage stabilizing transformers to help prevent voltage fluctuations from affecting your product uniformity, end product dependability, or production cycle continuity.

If rejections due to voltage fluctuations are causing you to lose money and man-hours, G-E voltage stabilizing transformers provide the most economical way to correct such losses in most commercial and industrial applications. If the performance of your products depends on stable voltage, G-E voltage stabilizing transformers are components you can't afford to leave out of your product design. And if production cycle continuity means dollars to you, G-E voltage stabilizing transformers in your plant will help prevent momentary voltage surges from shutting down production lines and damaging equipment.

For more information and other reasons why General Electric voltage stabilizing transformers will help keep your costs down and production up, contact your nearest General Electric Apparatus Sales Office or distributor today. Or, write for bulletin GEA-5754 to Section 410-43, General Electric Company, Schenectady 5, New York.

PRODUCTION CYCLE CONTINUITY In the Ford Motor Company's new Mahwah, N. J. assembly plant, G-E voltage stabilizing transformers are used to stabilize control voltage on over 11 miles of assembly lines. More than 60 G-E units help keep production flowing during line surges caused by electrical storms.

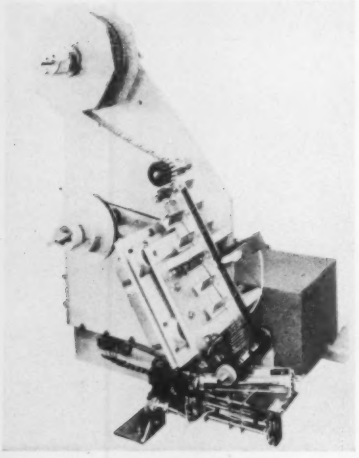
PRODUCT DEPENDABILITY Electronic Research Associates, Inc., Nutley, N. J. uses G-E voltage stabilizing transformers *exclusively* on its line of tubeless transistor equipment. Reliable service evidenced by no field failures in over five years and space saving design are two main reasons why these G-E units are used.

Progress Is Our Most Important Product

GENERAL ELECTRIC

adjustable, preset depths of cut; two speed and feed changes can be preselected for operation in any pass, combination of passes or all passes.

Features are a low spindle inertia with quick *start* and *stop;* simple efficient drives, automatic pressure lubrication of all parts; infinitely variable feed ranges; twin hydraulic pumps, and an oversized, air-cooled clutch-brake unit. **Cleveland Hobbing Machine Co.,** 1311 Chardon Rd., Cleveland 17, O. —*Circle 409



Taping—De-Taping Units

Item 410—

Applicable to manufacturers who supply their components on tape-reels and to firms using automatic insertion equipment and printed wiring on assembly lines, taping and de-taping (shown) units are designed for use with automatic test equipment.

Components to be taped are fed into the hopper of the taping device and with the aid of vibration stacked and oriented in the chute. A pick-off wheel at the bottom removes the components individually and applies them to pressure sensitive tape. A photoelectric device automatically *starts* and *stops* the reel in accordance with the level of the components in the hopper.

The equipment can also be used as an output device on automatic test equipment by placing the input hopper underneath the ejection position of the automatic tester. Components meeting test requirements are automatically taped while rejected units are ejected at another position. Adjustment is provided to accept most axial lead components.

The de-taping unit can be used as the input device, feeding components to the automatic testing equipment. The unit accepts components on reels, removes them from the tape and feeds them to the orienting chute. A driven high-speed indexing drum at the bottom of the unit revolves the components to a test position or position for other operations that it may be necessary to perform. **Industrial Instruments Automation Corp.,** 89 Commerce Rd., Cedar Grove, N. J.
—*Circle 410

Punch Press Feed

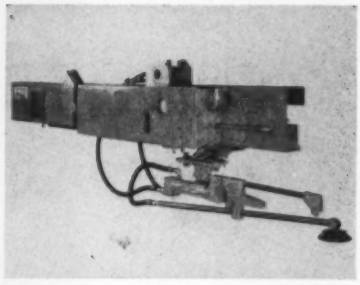
Item 411—

Machine developed to handle material such as paper, plastic, fiber, or cold rolled steel, in thicknesses ranging from 0.003 to 3/16-inch. Automatic punch press device can be mounted to feed in any direction for any type of die, piercing, blanking, compound, progressive or draw. Mechanically operated, accuracy of feed is unaffected by temperature changes.

The 12-inch Rol-Di-Feed requires no connection to the crankshaft of

the press and utilizes almost all of the full 360 degrees of press shaft rotation, feeding on the upstroke and also on the downstroke. This arrangement permits stock feeds up to 12 inches per cycle, even on deep drawing or forming dies where only a fraction of the total press stroke is available for feeding purposes.

The feeds can be mounted on the press bolster, or the die shoe in some instances, to feed from left to right, right to left, front to back, back to front, or at any angle. **H. E. Dickerman Mfg. Co.,** 321 Albany St., Springfield, Mass.
—*Circle 411

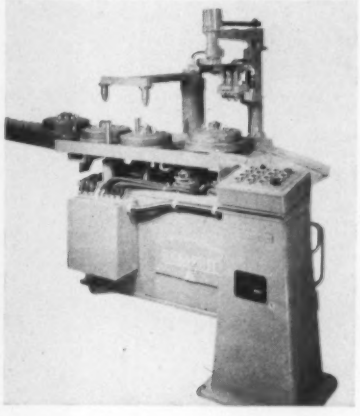


Press Unloader

Item 412—

Unit developed for automatic handling of sheet metal parts in stamping presses as well as parts in plastic molding machines. Partial vacuum is drawn in a rubber suction cup on the end of an adjustable rod for securing a part and is released to unload the part. The rod is pivot-mounted and advanced and retracted by an air cylinder control. The unit operates on 45 psi line pressure.

The rubber cup automatically conforms to both flat and curved surfaces, and will handle a wide variety of part shapes and sizes. **Press Automation System Inc.,** 25418 Ryan Rd., Centerline, Mich.
—*Circle 412



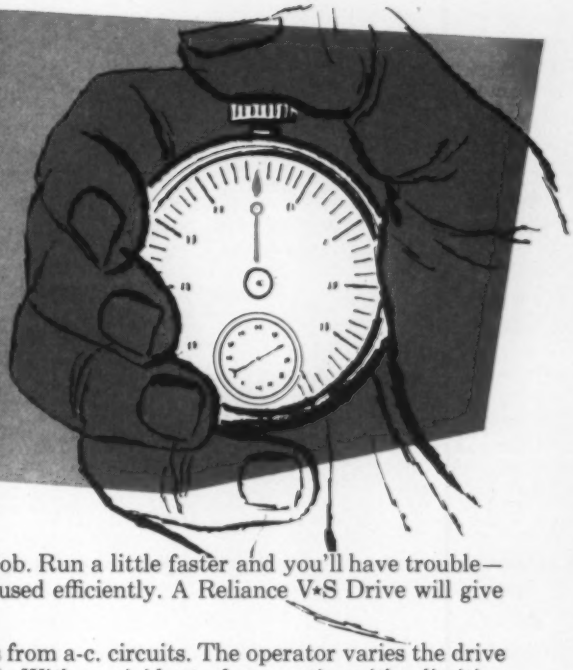
Balancing Machine

Item 413—

Tires, tire and wheel assemblies, brake drums, and other parts can be balanced at a rate of 300 pieces per hour, with automatic balanc-

*For Inquiry Card, see page 17

how do you measure your production?



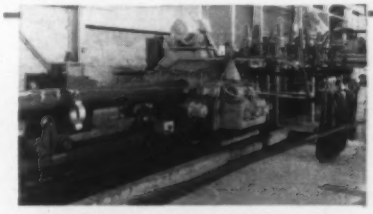
There is a *just-right* production speed for every job. Run a little faster and you'll have trouble—a little slower and your equipment is not being used efficiently. A Reliance V*S Drive will give you the *just-right* speed for each job.

Reliance V*S is an all-electric drive that operates from a-c. circuits. The operator varies the drive motor rpm. to set up the ideal speed for every job. With no rigid set of gear ratios with a limiting number of speeds, he has an infinite selection of rpm.'s from a wide flexible band of operating speeds.

There is a V*S Drive designed for your equipment. Write for Bulletin D-2311.

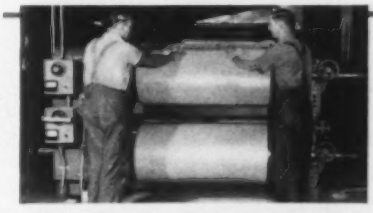
• TONS PER HOUR

In order to maintain a uniform production rate of 80 tons per hour with varying sizes of pipe, this pipe mill must change its line speed from 30 ft. per minute to 80 ft. per minute to compensate for differing gauges of steel. A 500 hp. multi-motor V*S Drive does the job.



• YARDS PER MINUTE

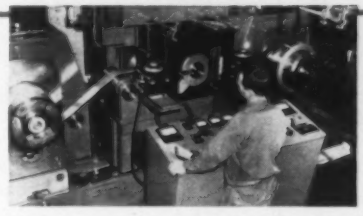
In order to properly size differing types of cotton cloth, the textile slasher must operate at line speeds varying from 28 yds. per minute to 225 yds. per minute. A 25 hp. V*S Drive does the job.



• REVOLUTIONS PER MINUTE

In order to maintain the correct tension on the metal on this highly accurate rolling mill, the speed of the coil winder must decrease from 900 rpm. to 450 rpm. as the diameter of the roll builds up. A 20 hp. V*S Drive does the job, automatically.

D-1563



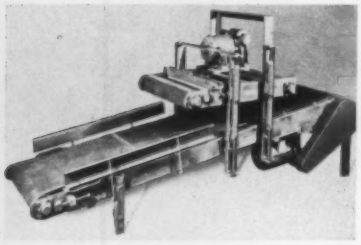
RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 268A, CLEVELAND 17, OHIO • CANADIAN DIVISION: WELLAND, ONTARIO

Sales Offices and Distributors in Principal Cities

Circle 680 on Inquiry Card

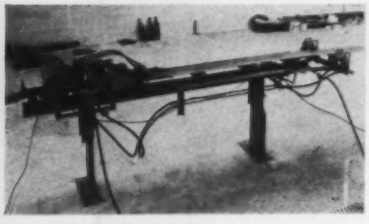
ing machine. A standard sensing device transmits information with respect to amount and location of unbalance to electrically controlled correction or marking devices, as required. No special voltage regulation is needed. Normal main voltage fluctuations will not affect the accuracy of the machine. **Micro-Poise Engineering & Sales Co.,** 14851 Grand River Ave., Detroit 27, Mich.
—*Circle 413



Bag Flattener

Item 414—

Device developed to facilitate stacking, bag flattener removes the air and compresses a bag. Both upper and lower decks are power driven. The amount of compression is arranged by adjusting the upper deck spring tension control. Standard machines are available in 16, 20 and 24-inch widths and 8, 10 and 12-ft lengths. **Sage Equipment Co. Inc.,** 30 Essex St., Buffalo 13, N.Y.
—*Circle 414

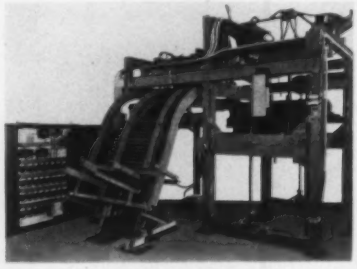


Coil Stock Feeder

Item 415—

Machine designed for feeding coiled stock of any width or thickness to blanking presses. Automatic feeder can be used with any coil and straightener and with any press without alteration to the press. The feed mechanism is mounted on a table which can be lowered or raised to new die heights. The table is equipped with a permanent type spacing bar which permits the carriage to feed the coiled stock in increments of from several inches to any number of feet. The bar can be quickly adjusted to obtain new lengths.

The feeder grips the end of the coiled stock and feeds it forward in the proper lengths to the press. When the carriage reaches the end of the table in its forward traverse, a series of grips seizes the stock and holds it in position. The carriage then automatically reverses and travels to the opposite end of the table where it takes a new grip on the stock and again begins to feed forward. The process is repeated until the coil is used up. All operation is fully automatic. The machine advances and reverses itself. The press operation is also tied up automatically with the action of the carriage, the carriage tripping the press as it strikes hardened pins placed at proper blank spacings in the template bar. **Pollasky Engineering Co.,** 3802 N. 38th St., Milwaukee 16, Wis.
—*Circle 415



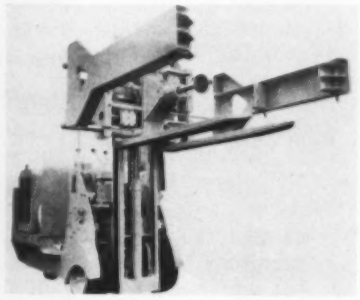
Tube and Bar Stacker

Item 416—

Machine is developed to handle tubes or bars, from a cut-off machine, and stack them in a storage rack ready for delivery to the assembly line.

As the tube or bar is released by the cut-off machine, two angle slides direct the tube to the bottom of the slide. Then a pair of steel blades lifts the tube up above a pair of dogs into the curved section of the machine, pushing the previously handled tubes up the inclined section to form a magazine fill. The entire layer of tubes is pushed up the curved section, to the top of the machine.

A mechanical drive assembly takes over to synchronize the action of the overhead transfer carriage and the lift table. The layer of tubes is lifted by a grab; transferred horizontally until correctly positioned over the storage rack on the lift table, then the layer of tube is deposited on the rack evenly and straight. The overhead carriage returns to its original position for a new magazine fill. **Spurgeon Co.,** 23501 Hoover Rd., Van Dyke, Mich.
—*Circle 416



Lift Truck Attachment

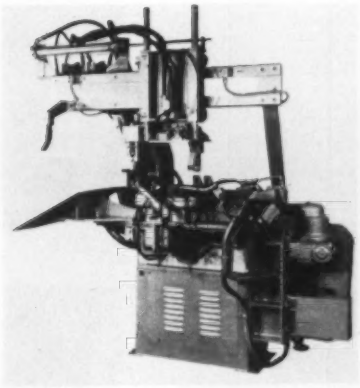
Item 417—

Machine is designed to facilitate bearing chock removal in steel rolling mills. Attachment for the Skylift LF-80 industrial fork lift truck enables one man to remove the bearing chocks weighing from 3200 to 4000 lb by merely running the Skylift up to the chock, taking its weight off the roll neck with the truck's forks, and at the same time clamping the chock on the sides with gripping arms. A hydraulic pushing ram then is powered against the roll neck, thereby pulling the bearing chock free from the roll. Fork spread is hydraulically adjustable to remove the coupling, and push-pull shoes on the gripping arms are easily set at any of 14 positions to suit the size of the bearing.

Bearing chocks were formerly

*For Inquiry Card, see page 17

removed by overhead cranes working with a crew of floor men. Bearing chocks are removed in order to place the worn rail in a lathe for grinding. After the grinding is completed, chocks are serviced and then installed on the roller by using the Skylift truck. **Automatic Transportation Co., Div., Yale & Towne Mfg. Co.**, 149 W. 87th St., Chicago 20, Ill.
—*Circle 417



Flash Butt Welder

Item 418—

Unit is designed to join the ends of long curved tubes that form part of an automobile exhaust cross-over assembly. Flash butt welder has a production rate of 240 parts per hour. The upper structure is a pickup and transfer mechanism for automatic unloading. Special tooling includes motor-driven upset and horizontal air clamp. The welder is rated at 75 kva. **Taylor-Winfield Corp.**, Warren, O.
—*Circle 418

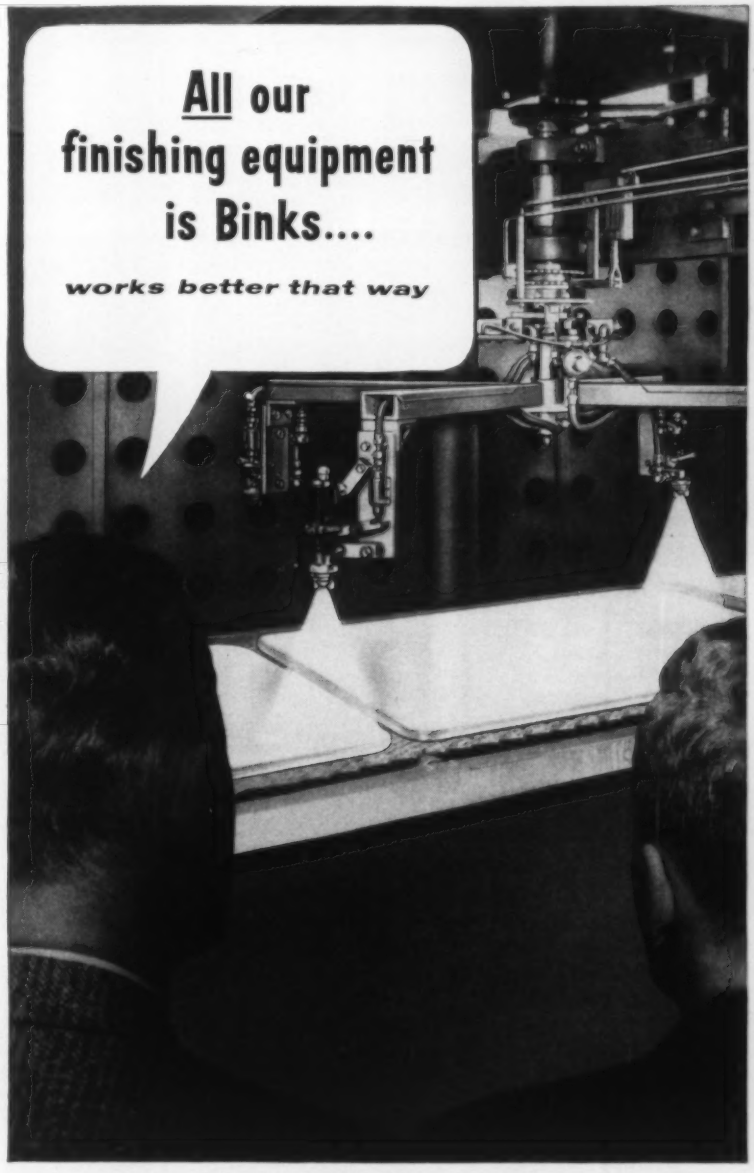
Coil Lifters

Item 419—

Line of hydraulic and electro-hydraulic coil lifters, of steel construction with V-type deck has been designed to facilitate the handling and lifting of coils of varying sizes.

The 4000-lb capacity hydraulic coil lifter handles coils with as much as a 48-in. overall diameter

*For Inquiry Card, see page 17



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for better, uniform finishes
SPECIAL SPRAY GUNS
for heavy materials
AIR COMPRESSORS
light, medium and heavy duty stationary and portable
MATERIAL HANDLING PUMPS
to pump from original drums
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for cleaner, drier air
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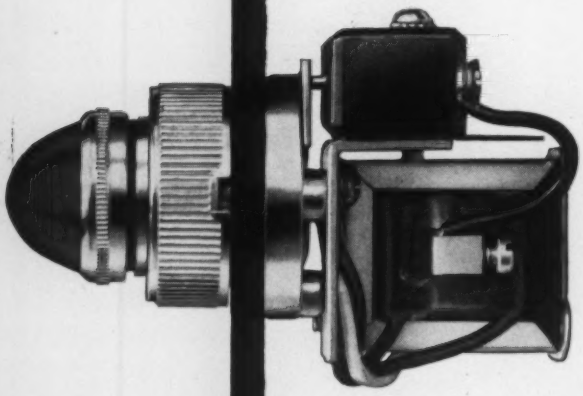
NEVER A DOUBT WHEN THE PILOT LIGHT'S OUT!

Don't guess next time your control line pilot light goes out. Make sure you're using Westinghouse Push-to-Test* indicating lights.

A gentle touch tests the light instantly because an auxiliary set of contacts energizes the bulb. When the light flashes on, you know there is



trouble somewhere else in the circuit.

Shock-resistant, U. S. Navy-type lenses with wide-angle visibility assure the best performance. They are available in crystal, red, blue, amber, green and opalescent—frosted to eliminate false indications.

Push-to-Test lights are only one of many outstanding units in the Westinghouse Oil-Tite* pushbutton line. For further information, ask for the new booklet (B-7022) or the *Pushbutton Guide* (B-6749), a 72-page catalog illustrating the complete line. Write to Westinghouse, Box 868, Pittsburgh 30, Pa., or call your local Westinghouse distributor. *Trademark J-30255

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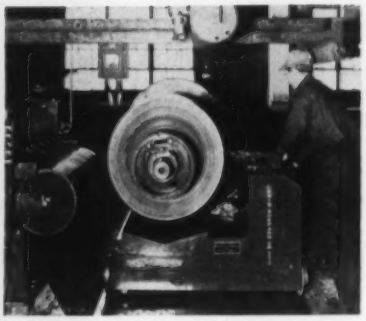
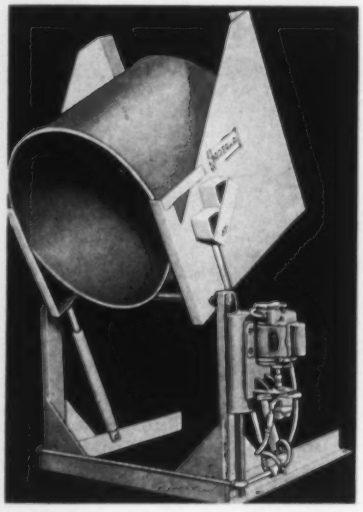
Westinghouse



and 30-in. width. The 5000-lb hydraulic foot lift coil lifter handles coils of 36-in. widths and 48-in. diameters.

Also available are hydraulic coil lifters with an 8000-lb, 10,000-lb or 20,000-lb capacity. **Lewis-Shepard Products Inc.,** 125 Walnut St., Watertown 72, Mass. —*Circle 419



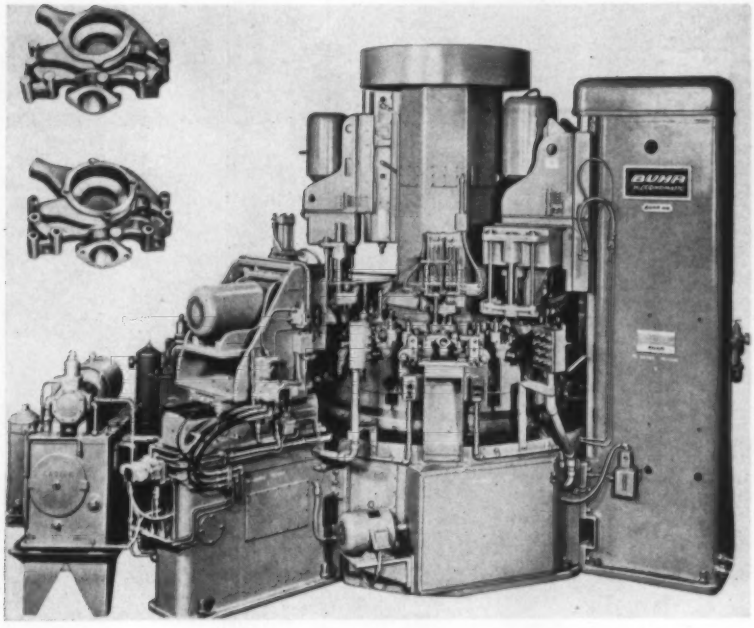
Hydraulic Dumper

Item 420—

Designed to elevate loads up to 2000 lb at heights up to 60 in., the twin cylinder hydraulic dumper features ruggedness, stability and ease of operation.

Highly portable, the electric motor driven dumper utilizes a 12v battery or conventional power line as a source of electricity. The unit is adaptable for dumping drums, vat boxes, box trucks and specially shaped containers. Tubar Dumper Div., **Uhrden, Inc.,** Dennison, O. —*Circle 420

For Inquiry Card, see page 17



Rotary Indexing Transfer Machine

Item 421—

Machine is designed to mill, drill, ream, chamfer, tap, spotface and bore automotive water pump housings, after mounting pads have been previously ground. Economatic can be converted to machine other parts, and the automatic index unit can be removed without disturbing any other part of the machine.

Features are automatic clamping of parts, automatic lubrication of fixtures and all moving parts, steel hardened and ground detachable ways, complete interchangeability of standard and special parts and automatic chip removal. **Buhr Machine Tool Co.**, Ann Arbor, Mich.

—*Circle 421

Insert & Closure Unit

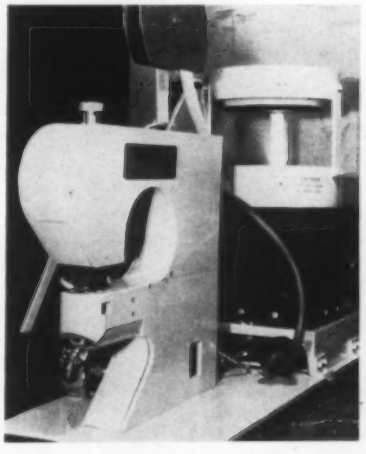
Item 422—

Ease of operation and rapid change-over to accommodate varying sizes of parts for different assemblies are features of the squeeze riveter machine.

The unit can hopper-feed and assemble one or two parts, die-cut a third part and fasten them to a fourth part. The change-over from one component part to another is effected in a few minutes. The working portion of the tool can be removed as a unit to accommodate different sizes of parts. Means are incorporated in the machine to handle a wide range of assembly parts, with adjustability for various sizes and thicknesses.

Power requirements are 30w of 110v, single phase ac and 90-lb sq in. of compressed air. **Aidlings Inc.**, 95 Liberty St., New York 6, N. Y.

—*Circle 422



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CONTROL FOR COMPRESSED AIR

Van Air DRYER

Unique in moisture-control, Van-Air Dryers do more than trap condensed liquids from compressed air lines. They remove vapor-humidity to *LOW DEW POINTS* besides eliminating water and solid impurities from raw compressor air.

Van-Air Dryers eliminate elusive trace vapors that condense at line-extremity temperatures and cause untold product spoilage, instrument failure and operational down-time. Where air must be of clean, dry, instrument quality as in automation, product finishing, processing foods, chemicals, plastics, etc., these Dryers are proving highly efficient—*AND*, they work for pennies instead of dollars. Available in many capacities up to 5000 SCFM and pressures up to 3000 psi. Van-Air Dryers are used by hundreds of plants from coast to coast.

When air-line moisture is a problem in your plant, Van engineers will be glad to help. Write or phone collect—Erie 3-5556. Meanwhile, ask for useful handbook, "Air, Water and Industry."

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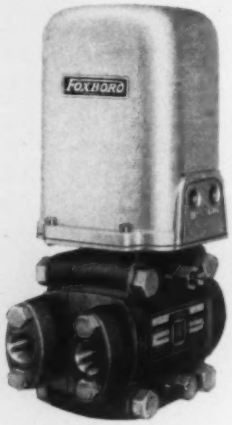
Differential Pressure Cell Transmitters

Complete line includes air-operated and electric-operated d/p Cell Transmitters covering ranges from 0-20" to 0-800" of water; working pressures up to 1500 psi.

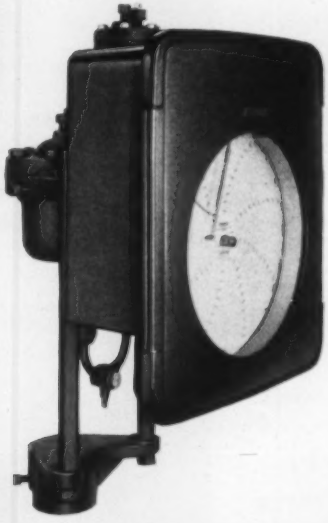


Type 13A d/p Cell Transmitter

- Positive Overrange Protection—up to full 1500 lb. rating
- Fully Adjustable Ranges—0-20" to 0-250" water
- Automatic Internal Damping — fast, stable measurement
- Simplicity—easiest, lowest-cost installation, lowest maintenance

Mercury Type Meters

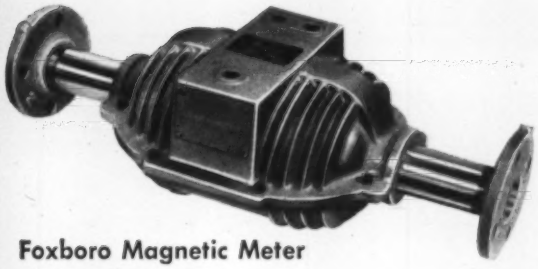
Complete line includes mercury types covering ranges from 2 to 400" of water; working pressures up to 5000 psi.



Type 28 Mercury Meter

- Permanent Full-Scale Meter Accuracy — exclusive segmental lever design provides linear transmission from float to pen
- Highest-Powered Pen Drive — large float with long travel
- Minimum Ambient Temperature Effects — float located in high pressure chamber

PROBLEM



Foxboro Magnetic Meter

- Measures Fluid Velocity Directly
- Adds No Pressure Drop
- Uniform Flow Scale
- Overall Accuracy Better than 1% of Range Over Entire Scale
- Full Accuracy Sustained Even on Liquids Other Meters Can't Handle — even sand and water slurries

THERE ARE two logical reasons why Foxboro Instrumentation assures you *optimum* results in measurement or control of process fluid streams. First; Foxboro offers the widest variety of measuring and controlling devices . . . the *right* equipment for every application. For example, only Foxboro offers all these basic meter types: differential pressure cell flow transmitters, magnetic meters, mercury meters, and weir meters. Second; Foxboro provides 45 years of engineering experience in every phase of fluid mechanics. From the simplest general utility-type instrument to complex automatic ratio control systems, you get highest accuracy, efficiency, and economy. Whenever you have a flow problem involving liquids, vapors, gases, or slurries — in pipes, ducts, or channels, you can solve it best by specifying Foxboro. Only a few instruments are described on these pages. For full details; or for specific information on your problem, contact your nearby Foxboro Field Engineer, or write **The Foxboro Company, 128 Norfolk St., Foxboro, Mass.**

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Float-and-Cable Type Meters

- Rigid Construction — weather-tight case; all working parts of corrosion-resistant materials
- Powerful Accurate Operation — large, high-stability float; stainless steel cable — non-stretching, non-twisting
- Direct Reading Chart and Scale
- Direct Reading Integral Counter

Other Foxboro Flow Instrumentation

Electric or Pneumatic Type Rotameters

Electric, Pneumatic, and Mechanical Integrators

Planimeters

All Primary Elements, Valves, and Accessories required for assembly of complete flow measurement and control systems

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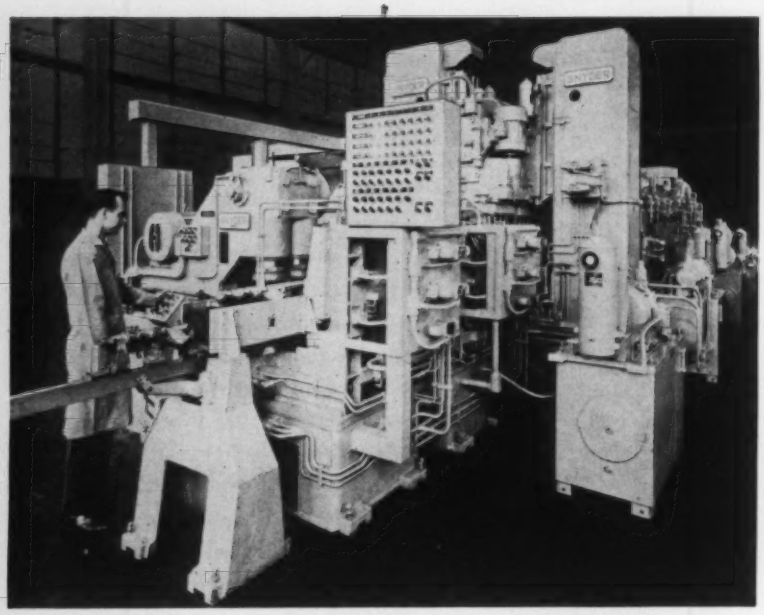


Segmented Transfer Machine

Item 423—

Unit mills, drills, chamfers and taps two different automotive engine exhaust manifolds at a net production rate of 136 manifolds per hour. Probing stations that check all holes and shut down the machines if any incomplete holes or broken taps are detected, are provided in four stations of the 28-station machine. Built-in sensing devices permit the two different parts to be processed through the operations at random.

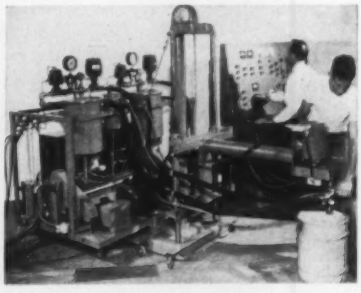
The machine is hydraulically operated and electrically controlled throughout. Separate hydraulic pump and tank units provide power for the standard way-type machining units. Each machine segment has its own individual control panel to facilitate maintenance and setup procedures. Automatic lubrication is provided for all moving parts on the machine. **Snyder Tool & Engineering Co.**, 3400 E. Lafayette, Detroit 7, Mich.

—*Circle 423

Plastics Blender

Item 424—

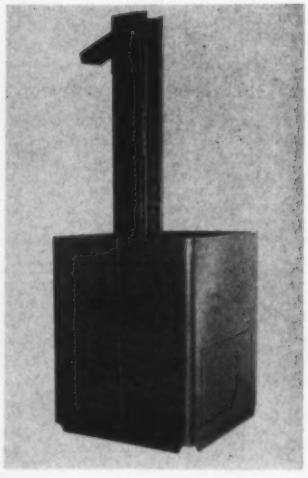
Unit developed to produce polyurethane foams, plastics blending machine is well suited for in-place applications, and also lends itself readily to automation. Material produced by the machine can be applied by a hand sprayer to achieve up to a 2-inch coating at any one spray pass. The machine is capable of making foam plastics of the polyurethane type —either the rigid, the semirigid, or the flexible foams. It is also capable of producing casting resin mixtures for epoxies or polyesters. The blender can be adapted for the spraying of resins and catalysts, whereby the materials are mixed in spray patterns, enabling spray coating of materials that have too short a pot life or cannot be premixed.



Automatic mixing control is provided on the control panel. Mixing is stopped automatically by the mixer timer which gives controlled times of 0.3-second to 120 seconds in increments of 0.1-second and stops the operation at the predetermined time. After the operation is stopped, the timer automatically resets itself and is ready for the next cycle, when the *On* button is pushed.

Unit may be constructed to process plastic materials and blend them at rates up to 30 lb per minute. It is possible to start up the unit with the system containing cold material that may run in viscosities as high as 50,000 to 70,000 cps. Automatic head motion or automated conveyors to move the molds under the head are available as optional equipment. **Martin Sweets Co.**, 114 S. First St., Louisville 2, Ky.

—*Circle 424



Elevated Bulk Hopper

Item 425—

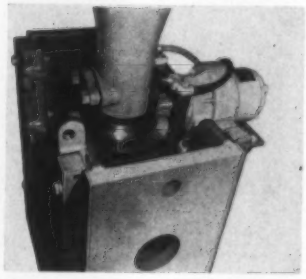
Electrically controlled unit designed for integration with standard processing machine, with feeds adjustable to a maximum of 20,000 pieces per hour. Model 7000 automatically feeds rolling, headed or sliding parts into small capacity hopper.

A continuous or intermittent flow of parts can be sent to small capacity hoppers or production at other elevated levels. In-process

*For Inquiry Card, see page 17

parts are picked up from storage hoppers, elevated, then fed down a gravity chute at an adjusted speed of the production process.

Capacity of the hopper is 6 cu ft with a variable belt speed and loading height of 36-in. **Production Feeder Corp.**, 3130 Johnnycake Ridge Rd., Mentor, O.
—*Circle 425

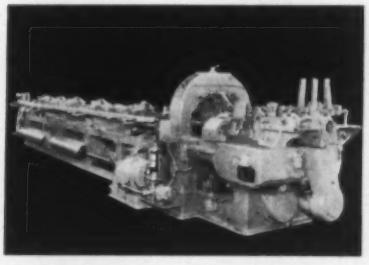


Motorized Ram

Item 426—

Suitable for short run press-work, motorized ram adjustment can accommodate, with multiple die sets, the forming requirements of a group of components.

Available with safety limit switches, the line is complete with capacities ranging from 90 to 215 tons. Single and double geared models can be obtained as upright, inclinable, permanently inclined or horn type. **Verson Allsteel Press Co.**, 9347 South Kenwood Ave., Chicago 19, Ill.
—*Circle 426



High Speed Bodymaker

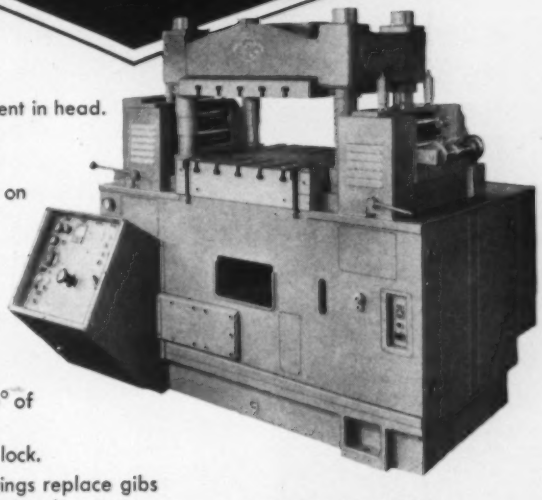
Item 427—

Machine makes tin can bodies at a rate of 455 per minute. Model 501 has foolproof automatic stops, at all stations throughout the machine, which stop the machine instantly if a jam starts to occur. All friction surfaces contacting the body are hardened and chrome-plated to eliminate scratching of the can. Interlocked controls integrate the operations of bodymaker and soldering machine. If the bodymaker is emergency-stopped, the soldering machine continues until all cans are removed from the soldering horn. If a jam starts in the soldering machine, both units stop immediately.

Features include the feed stack; feeding body blanks from the bottom, for complete flexibility for varying sizes and operating conditions. At the feed station, spring loaded snubbing and recoil pads stop the blank for precise pickup by feed bars. Notching slides, operated through a link and rocker

*For Inquiry Card, see page 17

ALPHA
TWO POINT
BACK GEAR UNDER DRIVE
PRODUCTION PRESSES
Capacity of 75 to 200 tons



Outstanding Features

- Shut height adjustment in head.
- Center drive type herringbone gears.
- Scrap cutter action on up-stroke of press.
- Cam adjustments for brake & roll feeds.
- Micro adjustment of metal travel.
- Timing of scrap cutter from 0° to 45° of up-stroke of press.
- Positive shut height lock.
- Bronze sleeve bearings replace gibs as utilized on conventional presses.

These precision presses are basically precision operating, high-speed automatic stamping presses. They have built-in precision in the same terms as the word "precision" is associated with modern machine tools. This inherent quality has been designed into these presses from the ground up.

NO PITS REQUIRED.

UNBALANCED DIES can be handled without distortion.

FAST, ACCURATE, WILL GIVE LONG TROUBLE-FREE SERVICE and LONG DIE LIFE.

PRESSES UP TO 300 TON CAPACITY, AVAILABLE TO CUSTOMER PARTICULAR REQUIREMENTS.

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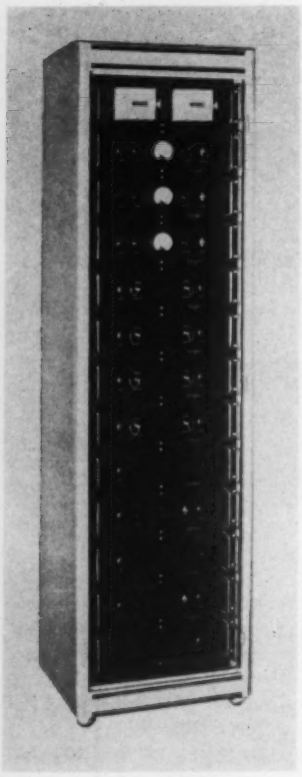
motion, are actuated by eccentrics on the main crankshaft. Die sets are high precision carbide with leader pins to assure perfect alignment. The main crankshaft is mounted on four bronze-backed, babbitt-lined split precision bearings.

All bodymaker stations at the tin line are mounted on two side gage castings which are adjustable for different can diameters within the range of the machine without disturbing the individual adjustment of each station. A side seam doping attachment, stream applicator type, is available where plastic side seam coatings are used. **Hamilton Div., Baldwin-Lima-Hamilton Corp.,** Hamilton, O.
—*Circle 427

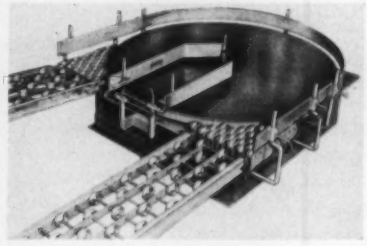


Moisture Detector

Item 428—

An electronic system designed for measuring and recording moisture content. The continuous moisture detector is applicable to a variety of non cellulose products such as cerals, wall board, tobacco, textiles, bakery products and other materials handled on moving conveyors. It is also used in the forest products industry for measuring and recording the moisture content of moving veneer and lumber and for marking any material which does not meet pre-selected moisture content standards.

The detector has a unitized system with primary circuits contained in lightweight replaceable type drawers. Power is automatically regulated for ac or dc and the system is unaffected by wide variations in line frequency or voltage. Moisture selectivity curves range from zero to 30% and moisture classification of moving material is governed by a single control. **Laucks Laboratories Inc.,** 1201 Poplar Place, Seattle 44, Wash.
—*Circle 428

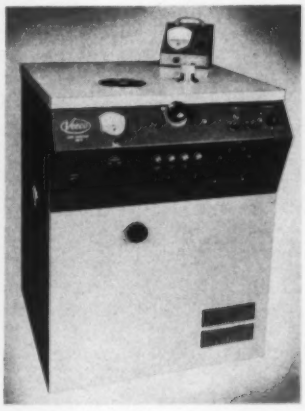


Powered Turntable

Item 429—

Unit designed for use with powered or gravity conveyors, powered turntable transfers packages or loads at either a 90 or 180-degree turn. The 48-inch diameter disk is directly driven by a gearmotor at 25 rpm to produce approximately 300 fpm rotation. The disk is supported by four rubber-tired ball bearing wheels which insure an even top surface under heavy loads.

Ball bearing wheel feeder sections assist in the smooth transfer of packages from conveyor to disk and back to conveyor. The feeder sections may be placed at any two corners of the turntable frame. Adjustable height outer and inner guards permit the turntable to handle packages of varied heights. The inner guard is pivoted at the center to permit adjustment for handling various types of packages. **Samuel Olson Mfg. Co., Inc.,** 2418 Bloomingdale Ave., Chicago, Ill.
—*Circle 429



Leak Tester

Item 430—

Machine capable of being extended to provide back-filling and other facilities including full go—no go automatic operation, self-contained leak tester is available in a mobile console. The basic unit is an improved mass spectrometer helium leak detector with a sensitivity of one part in 10 million. The console contains the auxiliary pump, manifold, solenoid valves and vacuum gages necessary for leak testing.

The Model MS9-AB is capable of 100 or more tests per hour. Automatic safety controls protect the system. **Vacuum-Electronic Engineering Co.,** 86 Denton Ave., New Hyde Park, N.Y.
—*Circle 430

Finishing Machines

Item 431—

Units are designed to perform contour turning, boring and facing; straight boring; surface grinding; surface honing; ID grinding; OD grinding; contour milling; and horizontal or straight milling, single-station finishing machines are designated the BL-1 Series. Used for jobs requiring

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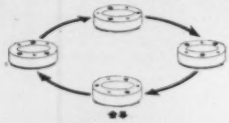
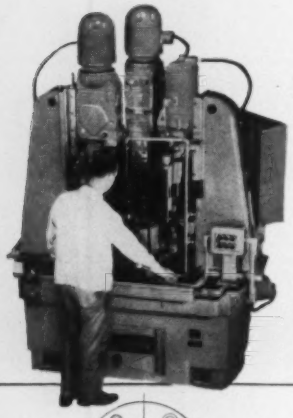
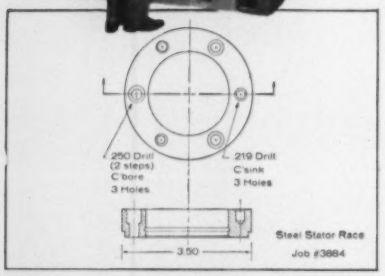
Leading Auto Manufacturer Selects
6 Greenlee Transfer Machines For
V-8 Engine Block Precision Machining Line
The entire installation has 127 stations and a machined block comes off the line at each cycle. This first unit drills and reams locating holes, mills main bearings to width; mills lock slots, oil seal and slinger grooves, fuel pump and filter pads and rough bores cylinders. It also has a gauging station to check locating holes, a reject station and three turnover stations, the last of which positions the block for the next machine.
WRITE FOR
COMPLETE INFORMATION
GREENLEE
BROS. & CO.
2088 MASON AVENUE
ROCKFORD, ILLINOIS

• DRILLED
• COUNTERSUNK
• COUNTERBORED

EVERY 12½ SECONDS







This Kingsbury indexing automatic performs these three operations on 290 steel stator races per hour (gross). Three vertical operating units have multi-spindle auxiliary heads. All tools have guide bushings to maintain accuracy. An air cylinder actuates the clamp.

Simple (like this) or complex, a Kingsbury is the best indexing automatic you can buy:

it will be fully tooled, ready to produce

it will meet your specifications for accuracy and production rate

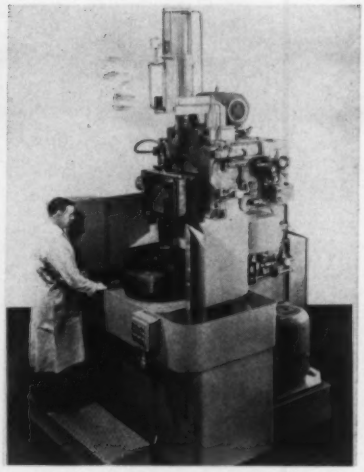
it will pay for itself in a matter of months

We have designed, built and tooled thousands of automatic drilling and tapping machines. It is our only business. May we come see you? Kingsbury Machine Tool Corporation, Keene, New Hampshire.

KINGSBURY

INDEXING AUTOMATICS for high production drilling and tapping

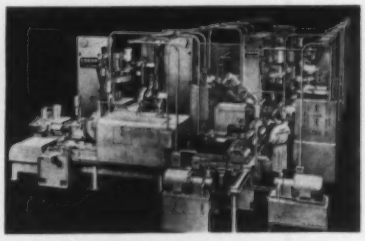
Circle 687 on Inquiry Card



rough and/or precision finishing operations, the machines utilize standardized, cam-actuated heads. Application of the interchangeable heads to a single-station machine makes available single, completely automatic cycles of operation.

The series is available in single or double-spindle models and with single, multiple or variable spindle speed drives. Motor drives from 3 to 20 hp per spindle are available. Cross slide travel is 5 inches; longitudinal slide travel is 6 inches. Other machine features include rapid slide traverse during idle time; vertical spindles for easy loading and more accurate seating of parts in chuck; accessible tool area; generous chip space; and optional high lift slides for loading of extra-large pieces. **Hoern & Dilts Div., New Britain Machine Co.**, Saginaw, Mich.

—*Circle 431



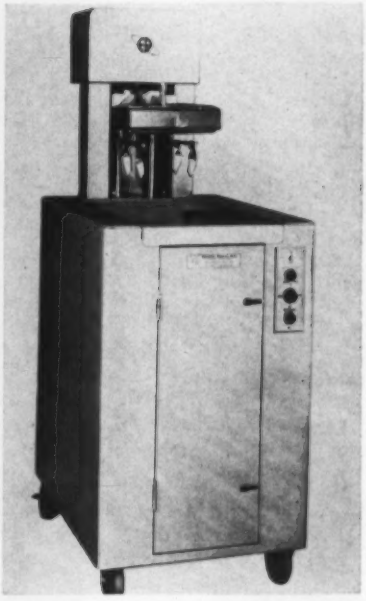
Machining Servovalves

Item 432—

Unit is developed to completely machine servovalve bodies for automatic transmissions. The 25-station Transfer-matic machine is designed for complete interchangeability of standard and special parts for easy maintenance. The construction provides flexibility for future changes in the design of the valve bodies. The machine produces 490 pieces per hour, performs 21 drilling, six reaming, five tapping, six boring and two precision facing operations.

An automatic washing unit for fixtures, hardened and ground ways, hydraulic feed, rapid traverse for milling, drilling and boring and individual lead screw feed for tapping are other features. **Cross Co.**, 17801 14 Mile Rd., Detroit, Mich.

—*Circle 432



Dip Soldering Machine

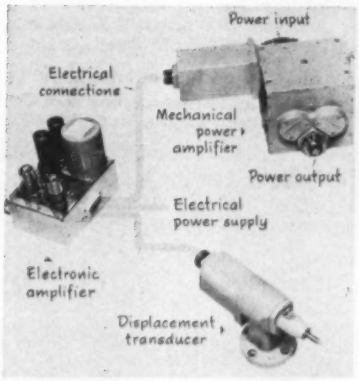
Item 433—

Outfit developed to facilitate semiautomatic production of electrical and electronic assemblies and circuit boards utilizing printed and etched circuit techniques, dip soldering machine has a capacity of 120 units per hour and requires only one operator. Angle and depth of immersion of the work in the molten solder are adjustable. Dwell time may be set at any value from 0 to 57 seconds in 0.5-second increments. Solder temper-

For Inquiry Card, see page 17

ature, after adjustment, is automatically maintained at the desired level.

The machine is equipped with an automatic dross skimmer and a vibrator unit which removes excess solder from the work. The progressive rolling action with which the work engages the solder ensures proper soldering action. The solder device is only 24 inches wide and 32½ inches deep. **Electronic Products Corp.**, 322 State St., Santa Barbara, Calif.
—*Circle 433



Control Components

Item 434—

Suitable for use on tracer lathes, three control components have been designed for chip and coolant problems which prohibit the use of too delicate devices.

Displacement transducer is capable of sensing displacement of plus or minus 0.003-in. and supplying a linearly varying 60 cps electrical signal of 4 mv per 0.001-in. sensitivity. Built-in electrical switches sense both initial actuation and overtravel of the stylus.

Electronic amplifier provides power to a 60 cps 2 phase servo motor-tachometer from the stylus signal, and tachometer feedback adjustment for system damping control.

Mechanical power amplifier provides up to 1 hp of control output, using a low level servo motor-tachometer as the input device, taking its power from a constantly revolving shaft. **Seneca Falls Machine Co.**, Seneca Falls, N. Y.
—*Circle 434

*For Inquiry Card, see page 17

with **LIPE Automatic MAGAZINE LOADING BAR FEEDS"**

says Factory Superintendent Don Thomas*

Our production figures ran all over the chart when we were using stock-feeding devices equipped with feed-fingers. In addition to tricky set-ups and frequent re-sets, we lost a lot of polished stock which had to be scrapped or refinished when scratched or marred by feed-fingers. Operators suffered fatigue and strain trying to stay on top of these mechanical "prima donnas." Production suffered from the slow-downs resulting from all these factors.

Our first test run of a Lipe A.M.L. Bar Feed proved that every one of these "bugs" could be eliminated—permanently. It fed stock continuously . . . without feed-fingers . . . with no repeat motion for feed-outs . . . no down-time for adjustments or remnant removal. There was no cutting air: From 7:30 to 4:00 every turn of the spindles produced *work* . . . at a day-in-day-out delivery of 58% higher production! Our entire department is now equipped with Lipe A.M.L. Bar Feeds.

WRITE or WIRE for a FREE Lipe Sales Engineering estimate of production increases, savings and amortization time of Lipe A.M.L. Bar Feeds in your production layout.

*Photographer's models and pseudonyms used to protect company identity and confidential information.

LIPE ROLLWAY

Lipe-ROLLWAY CORPORATION SYRACUSE 1, N. Y.

BAR FEEDS • HEAVY-DUTY AUTOMOTIVE CLUTCHES • PORTABLE POWER HACK SAWS

Circle 688 on Inquiry Card

Stromberg-Carlson's new type "E" relay combines the time-proven characteristics of the type "A" relay with a mounting arrangement common to many other makes.

As the sketch above shows, our new frame mounting holes and coil terminal spacing allow you to specify these relays—*of "telephone quality"*—interchangeably with brands you have been using. Costs are competitive and expanded production means *prompt delivery.*

Welcome engineering features of the new "E" relay are—

★ **Contact spring assembly:** maximum of 20 Form A, 18 B, 10 C per relay.

★ **Coil:** single or double wound, with taper tab or solder type terminals at back of relay.

★ **Operating voltage:** 200 volts DC maximum.

You may order individual can covers in a choice of 3 sizes for the new relay, as well as for our type "A" and "C" relays.

For complete details and specifications on the "E" relay and other Stromberg-Carlson relays, send for your free copy of Catalog T-5000R.

STROMBERG-CARLSON

A DIVISION OF GENERAL DYNAMICS CORPORATION
TELECOMMUNICATION INDUSTRIAL SALES
111 CARLSON ROAD, ROCHESTER 3, N. Y.

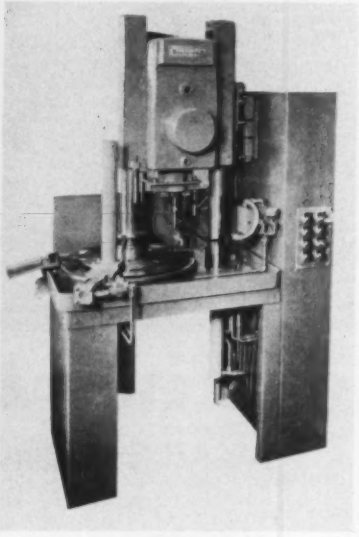
Circle 689 on Inquiry Card

Bore Honing Unit

Item 435—

Device developed for automatic honing of bores from $\frac{3}{8}$ to 2 inches in diameter, line of vertical machines is designed with mechanical and pneumatic actuation.

The basic machine has provisions for adding automatic equipment such as a rotary indexing table,



magazine feed, pregaging, bore-to-bore sizing by fluid, Plugmatic or time cycle sizing, pneumatic hone expansion with automatic rapid expansion, feed and collapse, post-gaging, sorting and ejection. Unit is also provided with automatic shutdown for continuous error or when stones are worn.

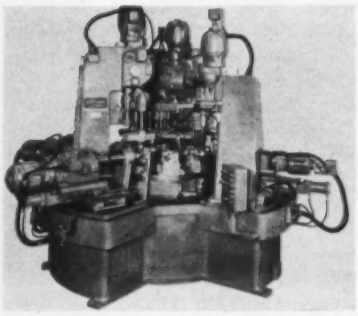
The illustrated Model #10A1 has a $\frac{3}{8}$ to 1-inch ID range with a 10-inch swing. The maximum spindle travel is $2\frac{1}{2}$ inches with a 6-inch liftout stroke. Power is supplied by a $\frac{3}{4}$-hp motor. Three other machines in this line are available. **Barnes Drill Co.,** 836 Chestnut St., Rockford, Ill.

—*Circle 435

Multiprocess Unit

Item 436—

Six-station horizontal indexing, drilling and boring machine is used to bore, face, hollow mill, drill and tap three different



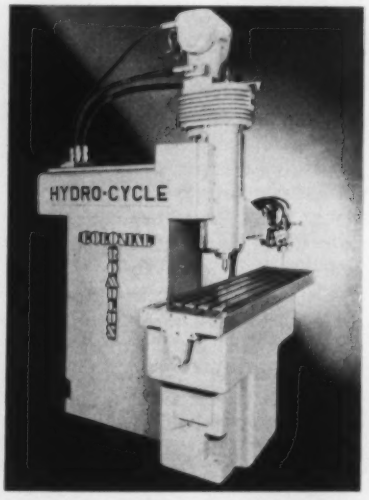
cast iron gear housings. Five cam feed drilling units and two lead screw tapping units are employed to process the parts. Horizontal units are provided with side adjustment to handle left hand parts. The loading fixture consists of interchangeable manually clamping nests. Production rate is 256 parts per hour at 100 per cent efficiency. **Hartford Special Machinery Co.,** 285 Homestead Ave., Hartford, Conn.

—*Circle 436

Contour Mills

Item 437—

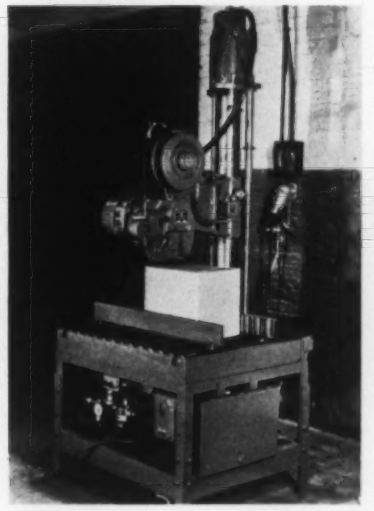
A hand-guided contour mill which can handle a variety of jobs in a big plant or small shop. Device is available as a complete machine or as a contour milling unit for building block erection. Both types are designed and built to contour mill a broad range of metals with an exceptional degree of accuracy. Applications range from



**For Inquiry Card, see page 17*

small forming dies to aircraft components.

Irregular contours can be cut without complex equipment with the hand control of the tracer stylus attachment. Tracer and template are offset for operator convenience and safety. Micrometer adjustments accurately control the desired relationship between master and workpiece. Spindle speeds are infinitely variable in a range of 40 to 3000 rpm. Full horsepower is available at all spindle speeds. **Colonial-Romulus Div., Colonial Broach & Machine Co.,** 21601 Hoover Rd., Detroit 13, Mich. —*Circle 437



Box Stitching

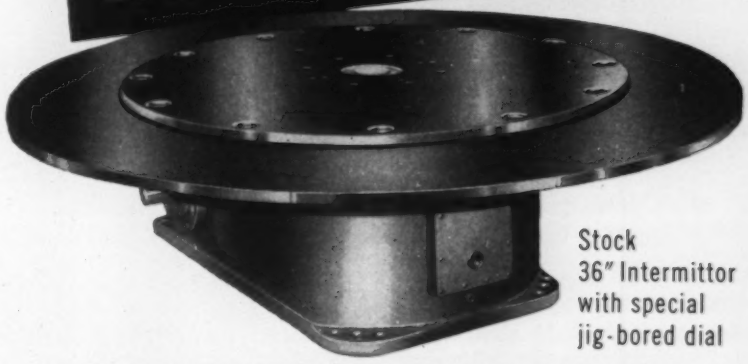
Item 438—

Circuate wire stitching is the name given to a box stitching method in which stitches are cut and formed from a continuous coil of wire, driven into both outer and inner flap with the mechanism entering the box. The method makes use of the N6 Series box stitching machines which have specially designed formers, shoes and wire arcing mechanisms, making self-clinched stitches possible.

Circuate stitching eliminates the need for retractible clinching anvils, thereby increasing production speed while reducing the chances of product damage. The

*For Inquiry Card, see page 17

STANDARDIZED AUTOMATION!



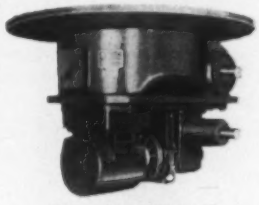
Stock 36″ Intermittor with special jig-bored dial

50% - 100% Increase in Production

with ***FERGUSON***

HIGH SPEED INDEX TABLES

Up to 30,000 Pieces per Hour



Standard Table and Power Section

Stand and Auxiliary Tool Mounting Plates

The standard Ferguson Intermittor is a *must* for operations such as machining, joining, forming, staking, piercing, assembling, testing and inspection that require a combination of high speeds, long dwell or work time, and smooth indexing.

There is a standard Intermittor for almost every application, offering a choice of stops, dial size, degree of movement; and a table for either extreme precision or high torque usage. Seldom do you have so much selection in a line of standard production machinery . . . with all of the benefits of standardization PLUS many of the advantages of custom designs! The Intermittor operates at speeds far greater than those possible with other types of index tables. The special acceleration characteristics of the FERGUSON ROLLER GEAR DRIVE insure smooth starting and stopping with little shock and vibration, at speeds up to 500 indexes per minute.

Over 150 standard models . . . many in stock! Get complete information on load ratings and dimensions . . . write for your file copy of Catalog No. 301.

HIGH SPEED INDEXING • STANDARD TRANSFER MACHINES • AUTOMATIC TOOLING

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Roller Gear Division, Dept. AI-8 • P.O. Box 5841, St. Louis 21, Mo.

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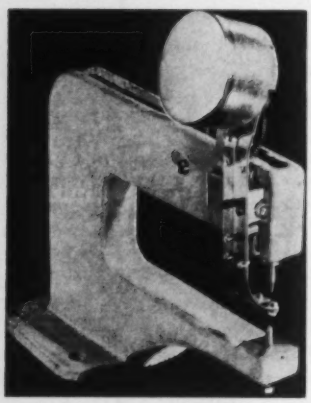
method is adaptable for simultaneously closing tops and bottoms of filled boxes (regular slotted or overlapping flaps), the sides and ends of filled five-panel folders, and two-piece telescope type boxes as well as sides, ends, tops and bottoms of outsize containers.

Flat stitching wire is drawn from a continuous coil mounted on the stitching machine, and an arc is formed in the cross section of the wire. The stitch is then cut and formed in the conventional manner, except that the legs of the stitch are slanted inward as the stitch is driven into the box flaps. The inward curving motion of the stitch legs continues as the stitch is driven until it is self-clinched inside the inner flap. Up to 700 average size boxes can be stitched per hour. Illustrated Model N6A17 with top and bottom stitching units is designed to close simultaneously at high speeds the tops and bottoms of filled boxes, either regular slotted or overlapping flaps. It is easily integrated into conveyor line packaging systems. **Acme Steel Co.**, 135th & Perry Ave., Chicago 27, Ill.
—*Circle 438



Eyelet Machine

Item 439—

Unit developed to speed the production of electronic printed circuits, novelty goods, electrical products, leather goods, and cloth and paper products. Model AE-2 can be equipped to handle small eyelets as those used in printed circuits or standard size eyelets with jam-free performance.

The eyelet machine has an extra large throat depth to handle work pieces up to 11-inches wide. Stroke length can be readily adjusted to prevent crushing, cracking or marring fragile materials. Maximum jaw clearance is 1¼-inch. **Eyelet Tool Co.**, 236A Broadway, Cambridge, Mass.
—*Circle 439

Tape-Controlled Jig Borer

Item 440—

Tape-controlled Fosmatic jig borer built for the General Electric Aircraft Gas Turbine Production Engine Department makes practical the use of jig borers for small and medium production runs, providing very close tolerances without special jigs and fixtures. This is due to the fact that a highly-skilled operator is not needed since the machine has taken over functions formerly dependent on the operator's skill and judgment.

In operation, the operator simply loads the part to be machined on the jig borer table, presses a button which positions the table to ±0.0001-inch and sets the spindle speed and feed according to values punched in the tape.

Tapes are prepared in the engineering department where the most efficient order of operations is programed. Dimensions from part prints are punched directly into the tape without the need for coding since a decimal tape punch is used.

Tools are set in the toolroom and numbered according to the operations program. The operator will only need to follow the program thus eliminating another opportunity for human error. Tape signals that determine *X* and *Y* positions actuate motor driven dials that line up required end measure gages whose values total the desired dimensions.

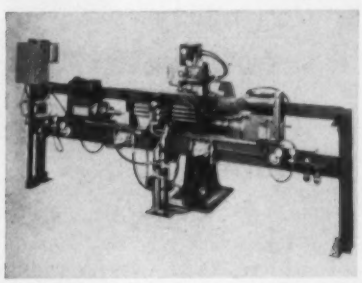
Movement of the table stacks the gages and moves them to operate a switching mechanism. At the point of final position, the table movement is stopped, the traverse screw is relieved by reversing it slightly and the table is clamped. **Fosdick Machine Tool Co.**, 1638 Blue Rock St., Cincinnati 23, Ohio.
—*Circle 440

Cutoff Machine

Item 441—

Straight, tapered and stepped metal tubes are de-burred and cut automatically with a new cutoff machine. Operation sequence: tubes are gravity-fed from a hopper, clamped, both ends drilled and faced, fed into cutoff machine by a short conveyor, and cut in half to produce two legs or lengths.

Model 3D cuts a minimum of 5000 tubes that are tapered from

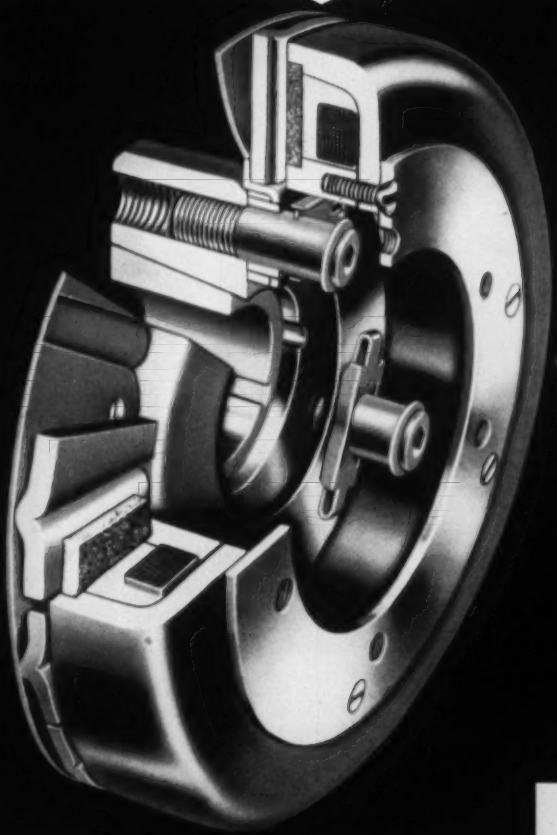


the middle, producing a total of 10,000 tapered legs a day. Both drilling heads are adjustable for tubes from 9-inches to 36-inches in length and 1-inch to 1½-inches in diameter. Basic design may be altered to fit various applications, lengths and diameters. Cutoff machine may be set for center or off-center cuts. **Continental Machine Co.**, 1952 N. Maud Ave., Chicago 14, Ill.
—*Circle 441

*For Inquiry Card, see page 17

Circle 735 on Inquiry Card→

THEY'RE NEW!



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FAST OPERATION • SELF ADJUSTING • EFFICIENT

SMOOTH, EASILY CONTROLLED ENGAGEMENT

WIDE RANGE OF SIZES AND CAPACITIES

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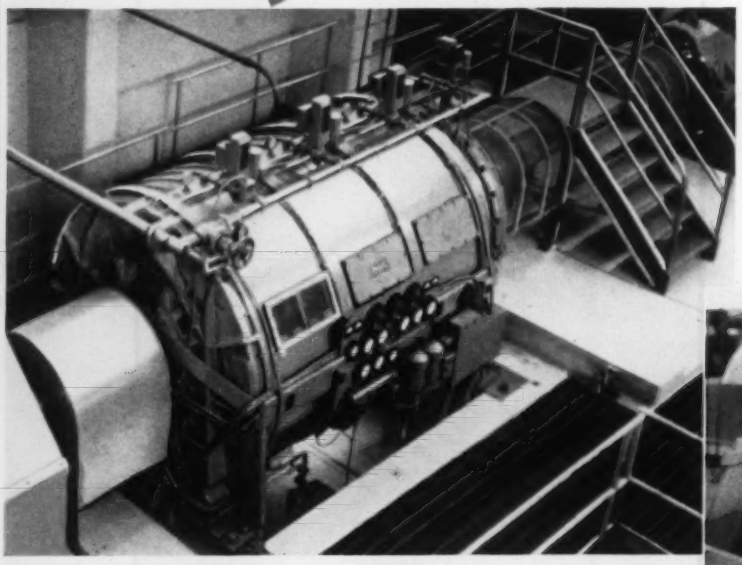

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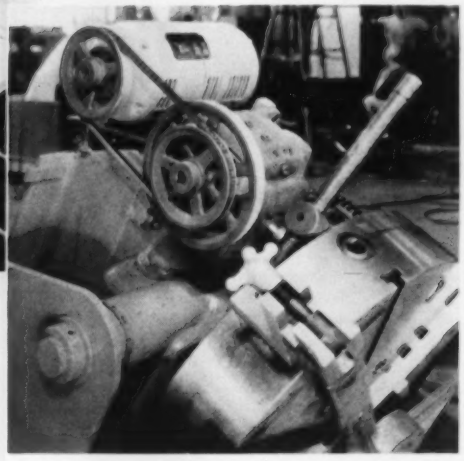

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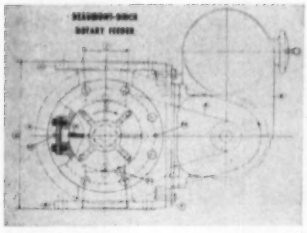
AUTOMATION new components

Parts, elements and devices designed for creating more automatic systems

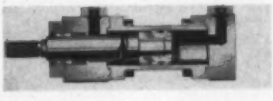
For detailed information and literature, use card page 17



Rotary Feeder

Item 442—

Machine designed for feeding bulk chemicals and other materials into industrial processes at differential pressure to 25 psi, rotary feeder features mating, v-shaped, floating seal rings. Outside adjusting screws permit adjustment of floating seals for maintenance of the seal without dismantling the feeder. Called the S.T.T. type, the unit is available in 4, 6, 8 and 10-inch sizes combined with a Reeves Vari-Speed Motordrive with ratios up to 10 to 1. The periphery sealed rotary feeder holds differential pressures of 2 psi and above. **Beaumont Birch Co.**, 1505 Race St., Philadelphia, Pa.
—*Circle 442

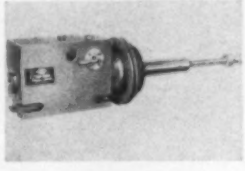


Fluid Power Cylinders

Item 443—

Designed for dependable, long life operation under the most severe operating conditions, a line of heavy-duty, 3500 psi, standard and large ram, double-acting cylinders is available in eight bore sizes from 2 to 8 inches. Length of stroke varies from 36 to 158-inches, with longer strokes available on request.

Features of the cylinder line are steel pipe-tap flanges; machined, bar steel heads; standard or large diameter ram sizes for each cylinder size; four automotive-type piston rings, and dual support bronze bushings. A choice of foot lug, center lug and flange head mountings can be combined or interchanged to suit any fixed mount application. Adjustable hydraulic cushions in either head, air vent plugs and double ram ends are also offered. **The Oilgear Co.**, 1560 West Pierce St., Milwaukee 4, Wis.
—*Circle 443

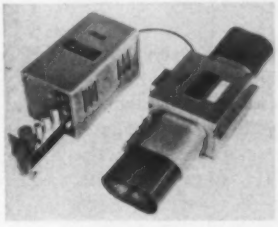


Precision Borer

Item 444—

Designed for special installations where space is limited, precision borer can be mounted on work-holding fixtures or assembly jigs. Model S-6 consists of a cylinder housing and oil reservoir, two Meehanite bearings, boring spindle assembly, control valve and spindle drive assembly.

Unit features a piston, with a modified square thread, mounted on the spindle and rotating within an oil-filled cylinder. This rotation causes oil to be displaced from the front to the rear of the cylinder and feeds the spindle at a constant rate. Rate of feed is determined by the lead and pitch of the thread. **Greenlee Bros. & Co.**, Rockford, Ill.
—*Circle 444



Automatic Dispatcher

Item 445—

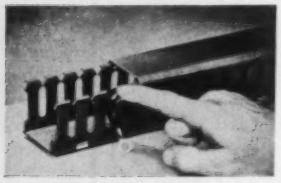
Unit designed for pneumatic tube systems or transmission of parts, materials or carriers by high-speed conveying means. A magnetic technique is used for coding the destination of each carrier. The carrier can be automatically dispatched to several different stations on several circuits.

When the carrier is in transit, small permanent magnets fixed to the carrier are positioned relative to a first magnet. It is detected at each loop switching point and station. Detectors consist of magnetic pick-up coils and an electronic control unit. Depending upon the

*For Inquiry Card, see page 17

magnet positions, the control unit causes switching or stopping action, or lets the carrier pass. The Magnepulse dispatcher can control carriers traveling up to 30 mph.

The instrument is applicable in hospitals, department stores, warehouses and industrial plants. It is also adaptable to other high-speed switching applications such as in wire, sheet and rod mills, and for processing and conveying where material can be coded by magnetics or similar methods. **Gemco Electric Co.**, 25681 W. Eight Mile Road, Detroit, Mich.
—*Circle 445



Snap-Slot Wiring Duct

Item 446—

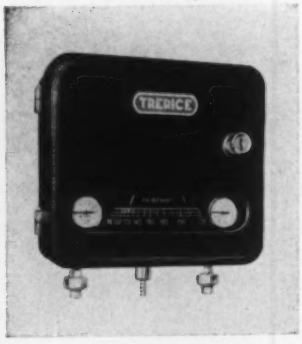
A snap-in open slot where wires can be installed in the duct with lugs already attached is feature of plastic wiring duct. The snap-in design eleminates the operation of threading wire through duct holes. To insert a wire, a plastic finger is pulled out, separating the slots, the wire is laid in the duct and the finger released.

Then a duct cover is snapped in place on the duct. Wires are securely contained but accessible for trouble-shooting and revisions. Cutting is done with snips or ordinary wood cutting tools. **Panduit Co.**, Dept. ANE, 10132 South Washtenaw Ave., Chicago 43, Ill.
—*Circle 446

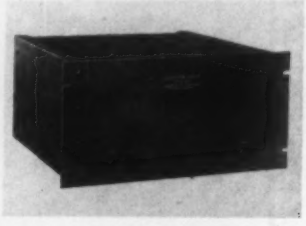
Temperature Controller

Item 447—

Mercury actuated, air operated indicating temperature controller is available in two basic types, *On-Off* fixed high sensitivity or proportional band. The controller can be changed from direct to reverse acting or vice-versa—without tools. The fixed high sensitivity controller is used on batch type processes, where *On-Off* valve cycling is satisfactory and where there is a large demand or load and small supply. The proportional band type offers throttling control of continuous flow processes, where cycling and overshooting cannot be tolerated, and is particularly adaptable to applications having variable time lags and capacities and where load changes are not frequent.



The controller is available in standard ranges to 800F and furnished with 5-ft heavy, flexible bronze connecting tubing, and ¾-inch NPT chrome plated union fittings. It is also available in a recording type model. **H. O. Trerice Co.**, 1420 W. Lafayette Blvd., Detroit 16, Mich.
—*Circle 447

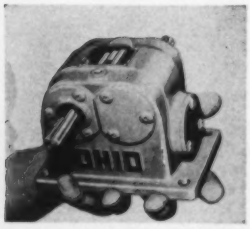


Power Supply

Item 448—

Unit can be automatically programmed by punched tape or any system which supplies binary-coded decimal signals. Voltages are selected by applying pulses to a group of relays operating in binary-coded decimal combinations. One-volt steps from −300 to +300 and currents from 0 to 200 ma.

Model 3-200P power supply is controlled by 13 sealed plug-in type Mercury-wetted or dry contact relays. Ten relays are used for voltage selection, two for polarity, and one for reset. A pulse from any 28v source operates any relay selected. The reset relay, when pulsed, restores the supply to zero voltage. **Dressen-Barnes Corp.**, 250 N. Vinedo Ave., Pasadena, Calif.
—*Circle 448



Speed Reducer

Item 449—

Unit is adaptable to conveyors, pump drives and light industrial applications. Redesigned, horizontal DOX double reduction speed reducer with zinc alloy housing is available in ratios of 4 to 1; to 1600 to 1. Torque capacity is 25 in.-lb, to 150 in.-lb, utilizing 1/6 hp motor. Furnished with roller bearings, reducers are available with bronze sleeve bearings. **Ohio Gear Co.**, 1333 East 179 St., Cleveland 10, O.
—*Circle 449

Sequence Programer

Item 450—

Unit provides automatic ten-circuit testing device for capacitors and other electrical apparatus requiring production inspection. Timer includes a selector switch for flexibility of operation from 115v to 230v. A complete cycle is generated by the cam shaft in 6 seconds and settings of the cams can be changed by adjustment of lock type bushings.

A calibrated setting disk simplifies accurate adjustments of each cam. Open bladed fine silver switches are contact rated for 15 amps. Self aligning bearings are used to assure smooth operation

*For Inquiry Card, see page 17

FORD BUILDS FOR THE FUTURE WITH

CYPAK

... controlling form grinder sequencing in automatic transmission production

CYPAK* static controls have already outlasted conventional relays previously used at the Ford plant in Livonia, Michigan. No down time for control maintenance has been necessary with this highly repetitive operation in over 17 months!

Logic and sequencing control of two Springfield Machine Tool Co. form grinders is performed by CYPAK static control apparatus. CYPAK activates the solenoids of hydraulic valves controlling the grinder's feed cycle.

In machining the impeller housing of automatic transmissions, the operator places the workpiece in the chuck, presses the cycle button ... and CYPAK does the rest ... automatically.

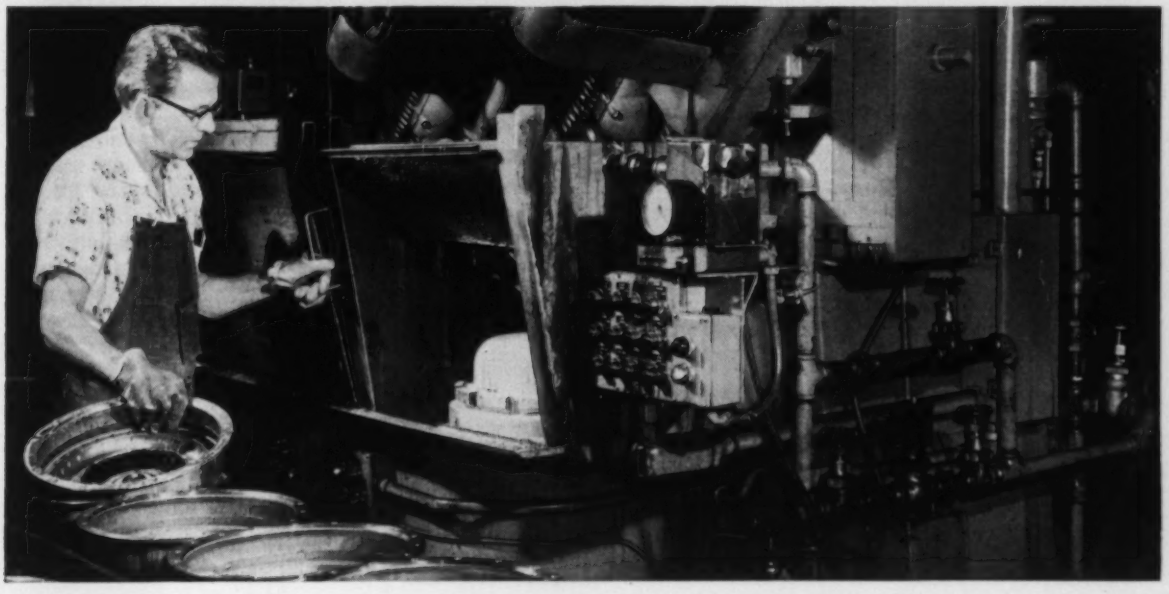
For complete information about CYPAK call your Westinghouse representative, or write Westinghouse Electric Corp., Dept. B, P.O. Box 868, Pittsburgh 30, Pa.

*Trade-Mark

J-22019

YOU CAN BE SURE ... IF IT'S

Westinghouse

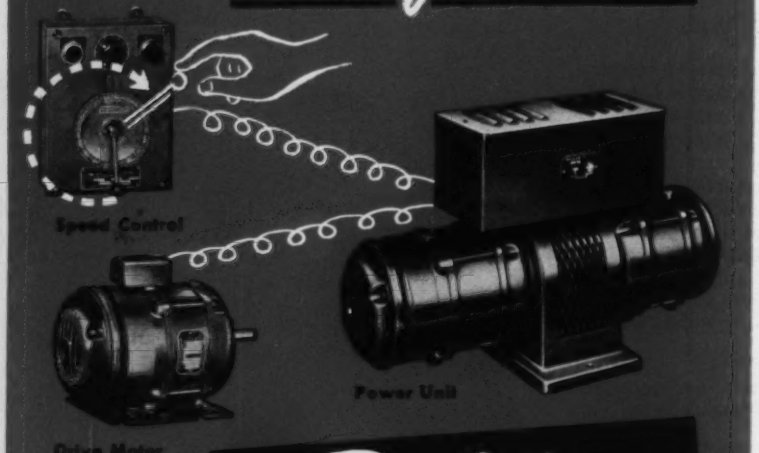


Circle 691 on Inquiry Card

30—STEP SPEED CONTROL

WITH A

twist of the wrist!



Baldor

ADJUSTABLE SPEED MOTOR SYSTEM

- **Easy to install...simple to service!**
- **No troublesome protective relays!**
- **No flashing contactors!**
- **No complicated electronic adjustments!**

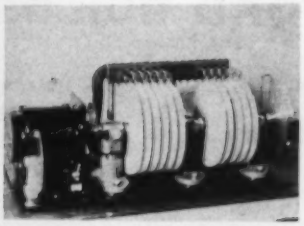
Specially designed for machines where friction or torque is constant from high to low speed. Motor-generator set, controller and drive motor can be mounted independently, in any position.

- *One* control for all adjustments. 0 to 2400 RPM in 30 steps of 80 RPM, forward or reverse.
- Totally enclosed Streamcooled construction . . . vernier rheostat for infinite speed control between steps . . . jog switch for machine adjustments . . . reversing switch changes rotation . . . many other features.
- Ideal for use on conveyors, pumps, mixers, shaker screens, packaging machines, fans and blowers, farm machinery, governor controls, similar machines.

For complete engineering data write for Bulletin SP-600

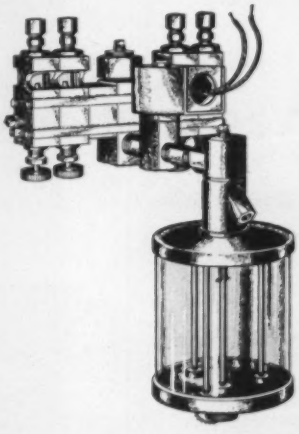
BALDOR ELECTRIC COMPANY

4353 DUNCAN AVE. ST. LOUIS 10, MISSOURI



over a long period of time, without incurring inaccuracies in switch operation due to wear.

Electrical switches can be replaced with direct acting pneumatic poppet valves for program sequencing of pneumatically operated devices such as diaphragm valves and cylinders. **Automatic Temperature Control Co.**, 5200 Pulaski Ave., Philadelphia 44, Pa. —*Circle 450



Precision Lubricator

Item 451—

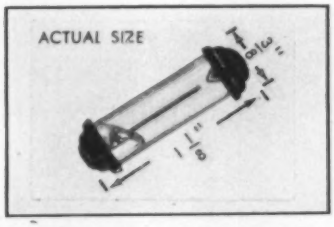
This new automatic lubrication system which feeds one or a series of bearings at a constant rate is afforded by electro oiler. The device eliminates any variation in drop feeding, since the oil which feeds the sight feed valve is always at the same level. This level is maintained in the base of the reservoir.

Operation is based on the liquid seal principle: When the oil level recedes because of oil consumption, the liquid seal on the spout is temporarily broken, allowing air from the air intake to enter the oil reservoir and releasing oil until the

*For Inquiry Card, see page 17

seal and the proper level are restored. The constant level of oil insures a steady rate of drop feeding regardless of the amount of oil in the reservoir.

The electro oiler can be supplied with single or multiple sight feed valves for individual flow to each bearing. Up to 24 sight feed valves can be separately adjusted and settings retained by means of a friction screw. Drop feeding of oil to widely separated bearings is controlled and observed from one central point. The solenoid valve is usually wired across the line of the driving motor, starting and stopping with the motor and providing automatic operation. The solenoid can also be energized by a switch or timer. Shutting off the oil supply with the solenoid valve immediately stops the drop feeding of the sight feed valves. **Oil-Rite Corp.**, 2312 Waldo Blvd., Manitowoc, Wis.
—*Circle 451



Mercury Switch

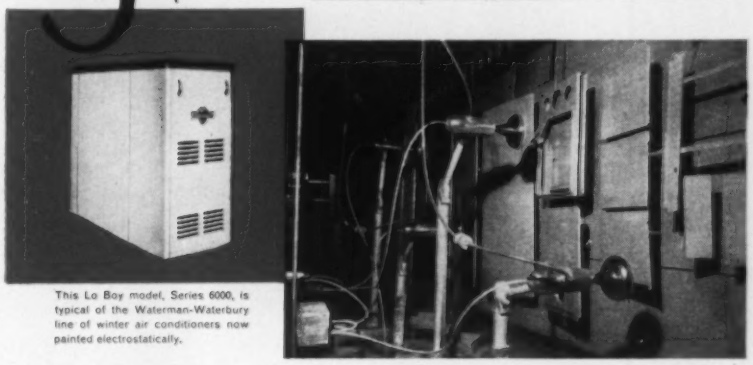
Item 452—

Suitable for use on coin operated machines, business machines, signals, sign flashers and refrigerator doors, hermetically sealed mercury switch may be clip-mounted, has rating of 1.75 amp, 115v or 0.6 amp, 230v.

Unit is comprised of a cylindrical glass envelope with metallic end caps, a pair of electrodes and a pool of pure mercury, sealed within the enclosure. One electrode is attached to each cap. The electrode ends are close together at one end of the tube and when the switch is tilted in that direction the mercury flows and bridges the gap between them to close a circuit. When tilted in the opposite

*For Inquiry Card, see page 17

3 times as many Furnace Casings per gallon of paint with **RANSBURG NO. 2 PROCESS!**



This Lo Boy model, Series 6000, is typical of the Waterman-Waterbury line of winter air conditioners now painted electrostatically.

Quality of work is improved; Labor costs are cut and Production Stepped up 150% with

RANSBURG Electrostatic Spray Painting

Results exceeded expectations when Waterman-Waterbury, Minneapolis, modernized their finishing department and went from hand spray to Ransburg No. 2 Process in painting their quality line of heating and air conditioning equipment.

By the former hand spray method, W-W used a half gallon of paint to coat a single casing. Now, with Ransburg No. 2, they get SIX CASINGS PER GALLON . . . or 3 times as many per gallon. Furnace casings, as well as other painted parts which go into the famous Waterbury Furnaces, now get a uniform coating of .8-mil.

Production was increased, too, as automatic painting enabled them to step up the conveyor speed from 7 fpm to 11½ fpm. Where they formerly turned out a complete furnace in five minutes, NOW they assemble three in just six minutes . . . an increase of 150%. All in all, they figure the modernization program—with Electro-Coating—saved over $11,000 in the first three months of operation.

NO REASON WHY YOU CAN'T DO IT TOO!

Whatever you paint, we'd like to tell you more about the efficiencies and worthwhile savings which can be yours with Ransburg Electro-Coating Processes. Get our No. 2 Process brochure which cites many on-the-job examples of electrostatic spray painting on a wide variety of products. Or, we'll be happy to loan you our new film, "The Big Attraction" which tells the electrostatic spray painting story in sound and full color.

Call or write

RANSBURG
Electro-Coating Corp.
Barth and Sanders, Indianapolis 7, Indiana

Circle 693 on Inquiry Card

available to industry

Ready for quick shipment to you . . . Kellogg's top-quality Cam Keys. The T frame construction allows any number of spring combinations of either locking, restoring, or both locking and restoring type. These Cam Keys are rugged and withstand the most severe breakdown test of any key on the market.

Kellogg supplies industry with a top-quality line of keys, relays, jacks, plugs, and other components. Inquiries on quantity lots invited.

KELLOGG SWITCHBOARD AND SUPPLY COMPANY
A Division of International Telephone and Telegraph Corporation.
Sales Offices: Dept. 88-L,
6650 S. Cicero Ave., Chicago 38, Ill.

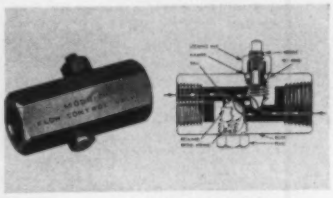
KELLOGG
A DIVISION OF I T & T
60 YEARS

KELLOGG SWITCHBOARD AND SUPPLY CO.
A Division of
International Telephone and Telegraph Corp.
QUALITY COMPONENTS FOR INDUSTRIAL CONTROL
QUALITY COMMUNICATIONS SYSTEMS

Circle 694 on Inquiry Card

direction, the mercury flows away to restore the gap, opening a circuit.

Operation is noiseless and contact position readily visible. **The Mercoid Corp.**, 4201 Belmont Ave., Chicago 41, Ill.
—*Circle 452



Fluid Control Valves

Item 453—

Unit composed of two types of valves in one compact body design. A floating retro-ball check provides full flow in one direction —a tapered, fine thread needle gives a wide range of adjustment of the flow in the opposite or controlled direction.

Fluid control valves are designed for pressures of 200 to 5000 psi in sizes from ⅛-inch through ¾-inch, for air, oil or water hydraulic use.

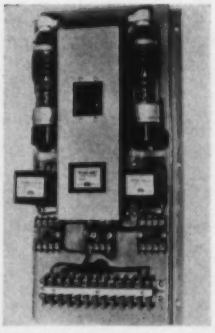
Valves are applicable for inlet and exhaust speed control for double acting cylinders; speed control of cylinders in parallel, and two-way speed control of a hydraulic pumping system. **Modrich Fluid Controls Inc.**, Crystal Lake, Ill.
—*Circle 453

Thyratron Amplifiers

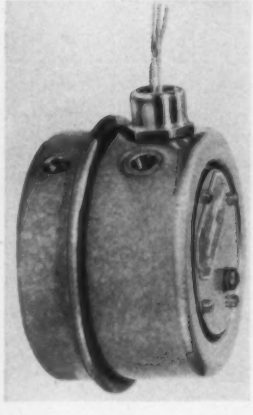
Item 454—

Suitable for use in power control devices, line of packaged thyratron amplifiers is offered with tube ratings from 2.5 through 18 amp output current, single-phase, one, two or three ½-wave operation and bridge circuits. The units meet all requirements for industrial operation and are designed for vertical panel board mounting.

Any type of motor drive positional servo, lighting or heating controller can be put in operation by connecting control elements,



control voltages or currents, load and feeback transducers. The amplifiers are available complete with packaged grid circuits, circuit breakers, warm-up time delay, spare plug-in sockets, power transformer and tubes. **Hanson-Gorrill-Brian Inc.**, 85 Hazel St., Glen Cove, N.Y.
—*Circle 454



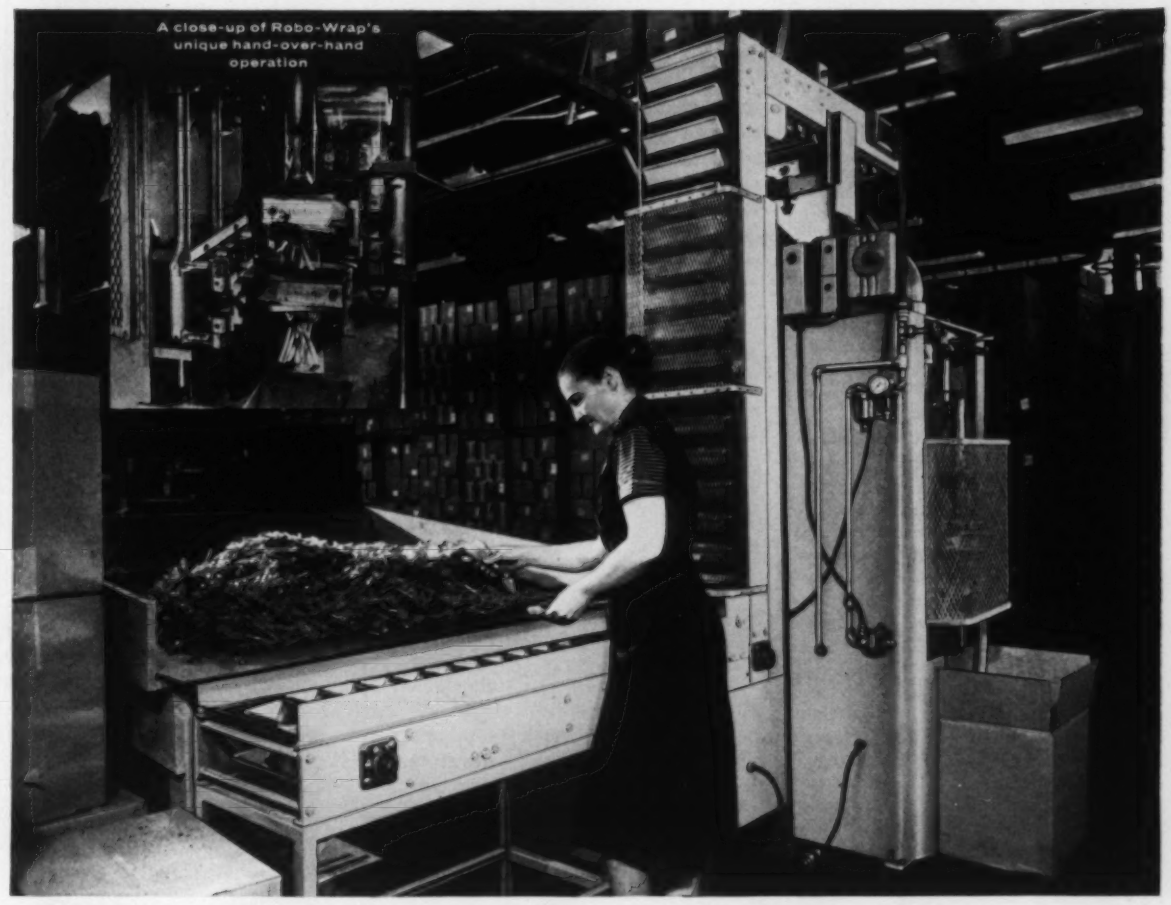
Differential Switch

Item 455—

Unit available in two classes for sensing pressure differences from 15 inches of water below atmospheric pressure to 80 inches of water above. The fixed actuation valve ranges from 0.2 inch of water to 2 inches of water depending on the switch setting.

Model 2273 will actuate an electric circuit on an increase or decrease of a predetermined pressure difference. The switch can be adjusted by means of an external adjustment screw for field setting. No leveling or special mounting is

*For Inquiry Card, see page 17



PACKAGING FLEXIBILITY PAYS OFF AT FEDERAL

A Lynch Robo-Lift elevating conveyor and a Lynch Robo-Wrap automatic unit packager combine to reach new production highs, lower packaging costs for the Federal Tool Corp., Chicago. Requiring but one operator, the integrated team produces an average of 45 packages a minute ... has the flexibility needed for quick changeover from one size to another. Manually fed, Robo-Lift takes the product "up 'n' over" for fast Robo-Wrap package forming, filling and sealing—all in one continuous action. The hard-working, Robo-Lift—Robo-Wrap team operates three shifts a day, six days a week... has logged just nine hours downtime in three months! Learn how Robo-Lift, Robo-Wrap packaging can serve you ... bringing lower maintenance and operating costs, increased output. Used individually, Robo-Wrap and Robo-Lift can be integrated with your existing equipment. Write for full details. Address Department A.

FEDERAL TOOL ROBO-WRAPS PLASTIC ITEMS OF VARIOUS SIZES, SHAPES

LYNCH ROBO
CORPORATION
A Division of
LYNCH CORPORATION
Anderson, Indiana

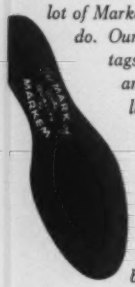
Circle 695 on Inquiry Card

MM

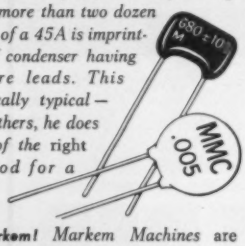
MARKED IMPROVEMENTS in

IDENTIFICATION AND DECORATION

Markem's original foothold . . . *in business was really just that: making marking machines for the shoe industry. Since then (1911), the shoe field, and nearly every other industry, has been using the Markem Method more and more. Where Markem was "in at the beginning", you'd expect to see a lot of Markem in the shoe business, and you do. Our 32A's imprint payroll coupon tags; jobs for the 1000, 24 or 79AB, and 105-10 or 45AC include quarter lining, match marking, heel pad and sock lining embossing. Currently, a brand new match marking machine is being field tested, along with some special marking compounds for "hairy" hide. Our "special" field, that began at the foot of the ladder, now reaches from one end of industry to the other.*



Nothing succeeds like . . . *successful use of Markem machines, it seems, especially with one of our electronics customers. Since 1952, they've bought 42 Markem machines of five different types: 20A's for cylindrical objects; a 25A for marking boxes, tape, etc.; half a dozen high production PLBR's for cylindrical objects; 45AG's for irregular shapes; and more than two dozen 45A's. Latest use of a 45A is imprinting a new type of condenser having right angle wire leads. This customer isn't really typical — but, like all our others, he does know the value of the right marking method for a given job.*



13 — 9 — 12 — Markem! *Markem Machines are used throughout "industry", but the things "industry" marks often end up in the corner store, gas station and gift counter. For example, you may not associate "industry" with "sporting goods", but several sporting goods manufacturers use the Markem Method. For example, one company had been sewing two separate fabric labels on football players' hip and kidney pads (we sent in a substitute illustration you'd recognize). Now, trade-name, size, etc. is imprinted directly on the outside of the curved fibre pads, with a 45A, effectively blocking label inventory problems and sewing costs. Maybe your "industry" has some unsolved marking problems. If so, we'd like to tackle them.*

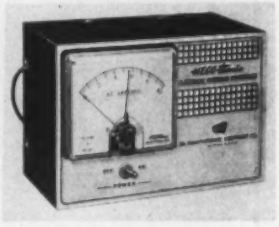
A letter, call or TWX could bring the marking help you need — or can use. The address is Markem Machine Co., Keene 37, New Hampshire.

MARKEM

Circle 696 on Inquiry Card

necessary; the unit will operate in any position.

A metal diaphragm gives accurate response. For exposed installations, a splash-proof housing protects the unit from dust or damage. **Pressure Switch Division, Barksdale Valves,** 5125 Alcoa Ave., Los Angeles 58, Calif.
—*Circle 455



Overload Controller

Item 456—

Applicable with any electrically driven equipment, such as mixers, agitators, conveyors, elevators, machine tools and pumps, electronic overload controller responds immediately to any increase in drive-motor current, providing a safeguard for equipment and personnel.

Use of the unit prevents shutdowns for motor repair or replacement caused by an overload. When the overload is removed, it automatically allows the mechanism to operate. One controller can be used to protect several motors. **Manufacturers Equipment Co.,** 218 Madeira Ave., Dayton 4, O.
—*Circle 456

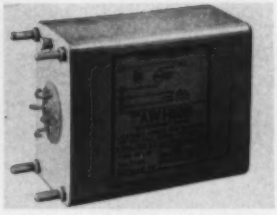
Time Delay Relays

Item 457—

All units in series available from 1½ seconds to 90 minutes. Timing accuracy is determined by the accuracy of the timing motor, which is dependent on line frequency or line voltage.

Chronometrically governed dc motors maintain accurate speed over a wide voltage range when close tolerances are needed. Repeating accuracy is specified as ±2% of the overall interval with constant motor speed.

Where the timer is exposed to

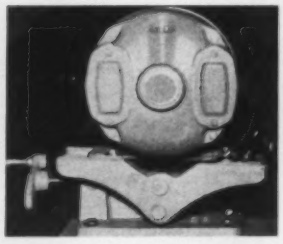


conditions such as humidity, salt spray, sand and dust, hermetically sealed housings are available. Standard or reverse clutch action can also be supplied. **A. H. Haydon Co.,** Waterbury, Conn.
—*Circle 457

Tilting Motor Base

Item 458—

Device compensates for belt tension when speed changes are made while the machine is running. Tilting motor base also makes belt



changing an easier operation. Unit has one base size for all fractional hp motors.

Correct belt tension and alignment are maintained by a handwheel screw adjustment which changes the angle of tilt. **Lovejoy Flexible Coupling Co.,** 4984 West Lake St., Chicago 44, Ill.
—*Circle 458

Hydraulic Valves

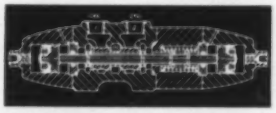
Item 459—

Suitable for use in a reciprocating circuit for controlled feed of a machine table, hydraulic four-way valve is air pressure operated by an air pilot valve. The air pressure feature of the hydraulic valve permits using it automatically when the air pilot valve is controlled mechanically.

In operation, the cycle is started

*For Inquiry Card, see page 17

by shifting the manual control valve, allowing oil from the power unit to pass through the air pressure pilot operated valve to the blind end of the cylinder, causing the piston to move forward. As the cam of the flow control valve is depressed, the required rate of speed of the forward stroke is obtained. When the pilot valve is



contacted, the pilot pressure shifts the pilot operated control valve and cylinder travel is reversed; the cycle is then repeated automatically.

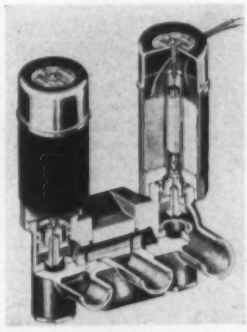
Model 5950 valve is available with standard action, spring-return or spring-centered. With a spring-return valve, the piston is moved to the original position when the pilot pressure is drained off. It requires one air pilot line for remote operation in one direction; spring-centered valves require air pilot lines to each end of the valve for remote operation in either direction, and when both pilot pressures are drained off, the piston is spring-centered.

Designed for 1500 psi pressure, the valves are offered in seven sizes: ¼, ⅜, ½, ¾, 1, 1¼ and 1½ inches. Spring-centered valves are available in five piston designs to meet the requirements of any hydraulic circuit; standard action and spring-return action valves are available in one piston design. **Rivett Inc.**, Brighton 35, Boston, Mass.
—*Circle 459

Double Solenoid Valve

Item 460—Suitable for use on air, water, oil or any fluid, solenoid valve is available in three assemblies for mixing, divided-flow and cylinder control operations.

The mixing valve has two inlets and a common outlet and can be supplied with oversize outlets to provide maximum flow. The divided-flow valve has one inlet and two outlets. Inlet can be supplied larger than individual outlets for maximum flow. The cylinder control valve has an inlet, cylinder



and exhaust connections. An optional check valve maintains pressure on cylinder if pressure source fails.

The valve is bubble tight and can be used at specific pressures ranging from 5 to 1000 psi with both pistons normally closed and at 5 to 500 psi with either or both pistons normally open.

Pipe sizes of ½ and ¾-inch are offered. **Atkomatic Valve Co. Inc.**, 545 W. Abbott St., Indianapolis 25, Ind.
—*Circle 460

*For Inquiry Card, see page 17

GEM-17 DIAL INDEX TABLE

TRUE GENEVA MOTION

FOR FAST, *ACCURATE* AUTOMATION OF ASSEMBLY *and* MACHINING OPERATIONS

This new, high precision index table is accurate to plus or minus 0.001 in. on a 13 in. dia. work circle; can position work in as little as ½ sec.; indexes a 1,000 lb. fixture load.

BASIC SPECIFICATIONS: Standard Number of Stations—6, 8 or 12; 3 and 4 skip. Motor—Rotary air, fluid, or electric. Dial Plate—17 in. dia. standard; larger plates available. Rotation—Either direction. Interlock—Limit switch operated directly off locking bolt. Weight—200 lbs.

Gray engineers will help you adapt GEM-17 to your use. For recommendations, send specifications of your application. Illustrated brochure GE-21 and prices on request.

GRAY EQUIPMENT COMPANY

13600 Ford Road • Dearborn, Michigan • Telephone: Tiffany 6-7573

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AUTOMATION STARTS WITH THE PARTS

KDI CORPORATION

43 FLINT STREET, ROCHESTER 8, N.Y.

SPECIALISTS IN

MECHANICAL HOPPERING

•

AUTOMATIC ASSEMBLY MACHINES

•

INTEGRATED PARTS PRODUCTION LINES

kdi

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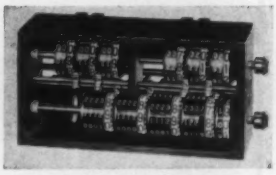


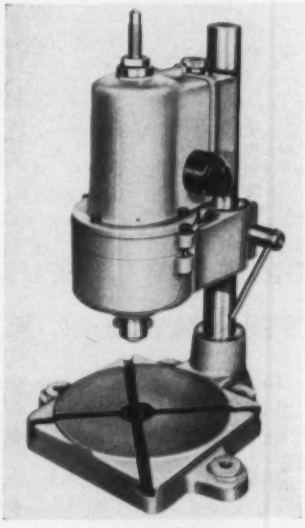
Programer Counter

Item 461—

Unit is applicable for starting sequence systems and wherever a plurality of switch contacts would be required at selective predetermined numbers. The programer is a double deck, end drive counter for rotary drive. It can close from one to eight or more switches at selective predetermined settings within a given range.

The speed is 500 rpm at input shaft—torque is 5.5-inch ounces maximum at input shaft for one switch actuation. **Durant Manufacturing Co.,** 1997 N. Buffum St., Milwaukee 1, Wis.

—*Circle 461



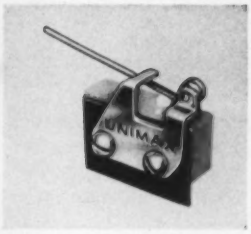
Electro Magnetic Press

Item 462—

Device capable of punching, jolting, drawing, bending, riveting, cutting or stamping. High speed electro magnetic press has a movable iron core traveling within the magnet which acts as a ram.

Stroke adjustment permits a choice of single stroke operation or multiple stroke operaiion over a range of 10 to 200 strokes per minute. Force of impact can be adjusted from 600 lb to 3½ tons. Compact size adapts to production line or shop utility operation. **McCauley Industrial Corp.,** 1840 Howell Ave., Dayton 7, O.

—*Circle 462



Lever-Actuator

Item 463—

Designed to provide light operate-force, Model ATM-1 actuator requires 40 grams maximum to operate the snap action of the basic switch. When used with the basic switch, pre-travel is approximately ⅛-inch and over-travel is 1/32-inch.

The mechanism is suitable for high temperature use up to 275F, and meets MIL-S-6743 requirements. **Div. W. L. Maxson Corp., Unimax Switch,** Ives Rd., Wallingford, Conn.

—*Circle 463

Pressure Control

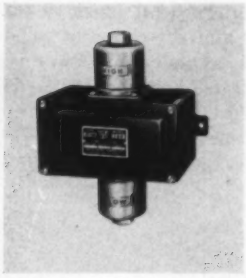
Item 464—

Capable of controlling accurately the difference in pressure between two pressure or vacuum sources, dual switch differential pressure control is designated Type J27KB.

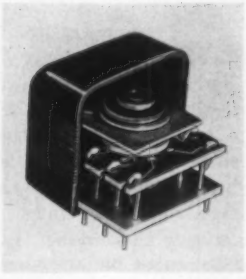
A separate adjustment screw in each switch is uncalibrated. The switches are actuated when the pressure on the high side exceeds the pressure on the low side by the preset amounts, regardless of the static pressure value. Switches can be set together to simulate double-pole circuitry or set apart to obtain independent operation.

Three standard types of

*For Inquiry Card, see page 17



switches are available; normally open, normally closed, or double throw with no neutral position. Line of seven models are offered with various system differentials up to 90 psi. **United Electric Controls Co.**, 79 School St., Watertown, Mass.
—*Circle 464



Shift Register Assemblies

Item 465—

Units are suitable for custom fabrication of magnetic shift registers for computing, telemetering and communication equipment. Operating currents for assemblies may be obtained from simple driver circuits. Read-out potentials are sufficient to directly trigger thyratrons. No external diodes are required.

Model MRC-10 is a five winding assembly with a printed circuit base, with two high impedance windings in addition to input, output and advance windings. Using the high impedance windings either individually or in series offers more flexibility.

A four winding assembly designed for use in standard nine-pin miniature tube sockets is also available. **Magnetics Research Co.**, 255 Grove St., White Plains, N. Y.
—*Circle 465

*For Inquiry Card, see page 17

Selecting the right hydraulic component for each requirement takes years of experience — years of hydraulic system design and application. Picking the right supplier for all your needs is another problem sometimes solved by using more than one source. The common denominator for all your hydraulic problems can be the product line and experience background of H-P-M. A complete line of pumps, power units, valves, cylinders and accessories plus 77 years of hydraulic experience is the answer in most cases. When you're planning hydraulically, call on H-P-M. Write today for Bulletin 1101 — the handy condensed catalog of the complete H-P-M line.

HPM

HYDRAULIC POWER DIVISION

THE HYDRAULIC PRESS MFG. CO.

Mount Gilead, Ohio, U.S.A.

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1877—1957

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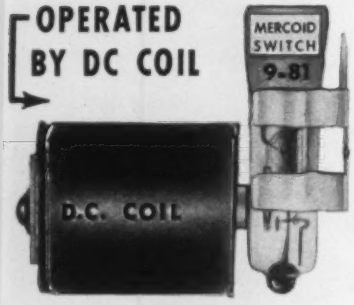
HERMETICALLY SEALED

MAGNET OPERATED

OPERATED
BY DC COIL



Mercoid Magnetic Mercury Switches remain fixed in position and require only a minute amount of power to actuate the external magnet which in turn opens and closes the circuit. Small DC coils can also be used to operate the switch.

MERCOID
Has These
ADVANTAGES

HIGH SPEED

Up to 200 operations per minute. Will provide millions of "makes" and "breaks."

SMALL IN SIZE

Switch diameter 3¾4", length 2".

VISIBLE OPERATION

You can tell at a glance whether switch circuit is "on" or "off".

PROVED

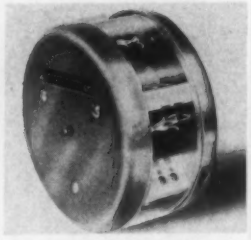
Backed by 35 years of engineering skill and field experience.

Various types of magnetic switches available. We also manufacture a complete line of tilting type switches. Our engineers are at your service—send in your switch problems or

WRITE FOR BULLETIN NO. 46

THE MERCOID CORPORATION
4201 Belmont Ave., Chicago 41, Ill.

Circle 700 on Inquiry Card

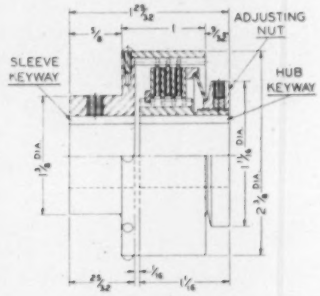


Magnetic Memory Drum

Item 466—

Suitable in data-handling systems and computer systems or utilized as a laboratory testing instrument, miniaturized magnetic memory drum can store over 12,000 bits of data and associated clock and reference information.

Drum is belt-driven with variable speeds to 15,000 rpm and contains twelve information channels. Clock and fiducial channels are an integral part of the aluminum drum. **Borg-Warner Corp.**, 3300 Newport Blvd., Santa Ana, Calif. —*Circle 466

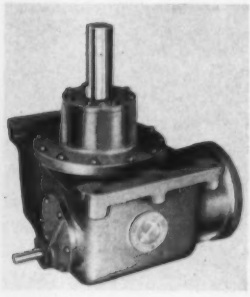


Slip Coupling

Item 467—

Device intended for general application to provide overload protection between small motors and reducers, conveyors, feeding mechanisms, packaging equipment and similar machines, light duty slip coupling is designated L2. Unit features metallic friction plates, available with bore dimensions of ½, ⅝, and ¾-inch diameter in either member.

The coupling is available with disk spring assembly. Type 323 has adjustable torque range up to 9 ft. lb. maximum. Type 323A has coil springs to provide the friction plate pressure. The size and number of coil springs can be varied and the coupling can be adjusted to suit any torque range from 0 to 7.3 ft. lb. **Hilliard Corp.**, 102 West Fourth St., Elmira, N. Y. —*Circle 467



Speed Reducer

Item 468—

Applicable for conveyor drives, speed reducer is designed for use on a vertical output shaft. A quick change of total ratio in the field with stock gears is made without disturbing balance of drive. Simple rearrangement from output shaft up to output shaft down, and vice versa, decreases maintenance time. **Anchor Steel and Conveyor Co.**, 6906 Kingsley, Dearborn, Mich. —*Circle 468

60-Cycle Chopper

Item 469—

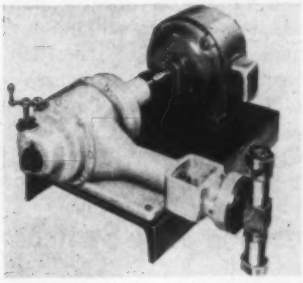
Unit is designed to convert a low level dc signal into a low level ac signal which can be further amplified to operate various types of control apparatus in null balance servo system, industrial in-

For Inquiry Card, see page 17

struments, and other automatic controls.

The chopper can also be used as a synchronous rectifier to convert low level ac signals to dc without loss. It is applicable in chopper stabilized operational amplifiers where minimum amplifier zero drift is important.

Standard coils with dc resistances from 13 ohms to 7950 ohms are available for a driving voltage range from 0.5v to 12v rms. **Barber-Colman Co.**, Rockford, Ill.
—*Circle 469



Proportioning Pump

Item 470—

Heavy-duty unit handles all types of liquids. Stroke length adjustment of capacity in all sizes is featured. Pump loads are taken by bearings on both sides of the eccentric. Moving parts operate in oil bath.

Gasket is enclosed at pressure points to prevent leakage. Three types of control are included in unit. **Capacitrol Pump Co.**, 15th St. & Fairmount Ave., Philadelphia 30, Pa.
—*Circle 470

Electronic Controllers

Item 471—

Units can be interchanged at the panelboard in seconds, allowing change-over from recording to indicating type, proportional-action to proportional-plus-reset action, slow reset to fast reset.

Replacement is made by pulling one unit out and plugging the other in. Proportional reset and rate settings can be made in ad-

*For Inquiry Card, see page 17

he **HAD** to use a polishing cloth!

but **YOU** can use a Buckeye Air Tool!

Why AIR Tools?

Because air is everywhere, just waiting to be put to work . . . because continuous operation can't possibly harm an air tool . . . and because, if you're using Buckeye air tools, you can almost forget about tool maintenance.

The old line craftsman, rubbing away diligently with his polishing cloth, took a great deal of pride—and a great deal of time—in his work. The modern craftsman, guiding a compact, lightweight Buckeye polisher or buffer, takes just as much pride in his work, and accomplishes far more in much less time. Mass production and pride of craftsmanship still go hand in hand, with modern Buckeye air tools.

In Air Tools, Your Best Buy Is Buckeye

Buckeye Tools CORPORATION
DIVISION 12 • DAYTON 1, OHIO

Circle 701 on Inquiry Card

STOP

Set Screw Skidding

Conventional

NU-CUP*® gives a better bite for greater holding power on small dia. shafts!

42%

Sharper point angle

60°

Setko exclusive Nu-Cup set screws end shaft slipping on even small shafts. The sharper point... 42% sharper than conventional cups... takes a better "bite". On small shafts, this gives a full circle impression, greater resistance to reversal with the same setting torque you're now using. And, Nu-Cup set screws are made of alloy steel, specifically heat treated to make higher setting torques possible... assurance against screw head cracking.

Automation... Setko Nu-Cup set screws can be hopper-fed! The new Setko System for hopper feeding headless set screws will orient and feed Nu-Cup set screws as small as #2 (.086" x 1/8").

Available in Popular Types...

Fluted Socket | Hexagon Socket | Slotted Head | Slabbed Head

MAKE THIS NU-CUP* COMPARISON TEST... *FREE*

You're under no obligation when you test Nu-Cup's greater holding power for yourself.

Nutcracker Test Tongs with complete instructions and sample Nu-Cup set screws will be loaned on request. Setko will also send a free copy of Catalog 21 with complete details on Nu-Cup set screws, and Setko's new System for hopper feeding headless set screws.

FAST DELIVERY SERVICE...

Setko delivers even the most specialized types of set screws promptly. You get exactly what you need, when you need it!

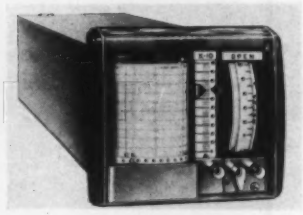
*U. S. Pat. 2,778,265

Set Screw & Mfg. Co.

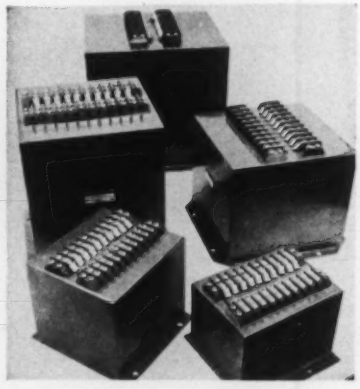
1501

268 Main Street, Bartlett, Illinois

Circle 702 on Inquiry Card



vance so that the process is on control the instant the changeover is completed. **Industrial Controls Div., Manning, Maxwell & Moore Inc.**, Stratford, Conn.
—*Circle 471



Saturable Reactors

Item 472—

High permeability magnetic devices designed for industrial control. Line of products consists of 22 standard reactor assemblies. Six amp turns will control nearly 2000w in the largest of the assemblies.

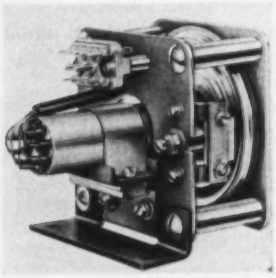
Power outputs range from 50 to 2000w, with only 3 amp turns being required for control of the smallest unit.

Eleven sizes each for 120v and 240v operation are offered. **Magnetics Inc.**, Butler, Pa.
—*Circle 472

Pressure Transducer

Item 473—

Suitable for use in data reduction systems, pressure transducer converts a 3-15 psi signal to ac mv directly proportional to the pneumatic input. Pressure applied to the sensing element of the transducer results in the movement of an expandable capsule, displacing an armature which induces opposing voltages in twin secondary coils.



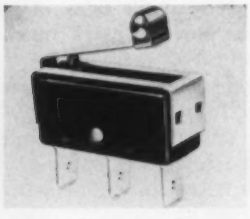
The voltage is linearly proportional to the pressure input. The output can be used to position an indicator, recorder or control device. **Fischer & Porter Co.**, 93 Jacksonville Rd., Hatboro, Pa.
—*Circle 473

Precision Snap Switch

Item 474—

Having high electrical rating of 15 amps, 125-250v ac, precision snap switch is designed for ganging and comes in a choice of operating forces from 3 oz to 12 oz on the pin.

The unit is available with solder, screw, standard spade or junior tab



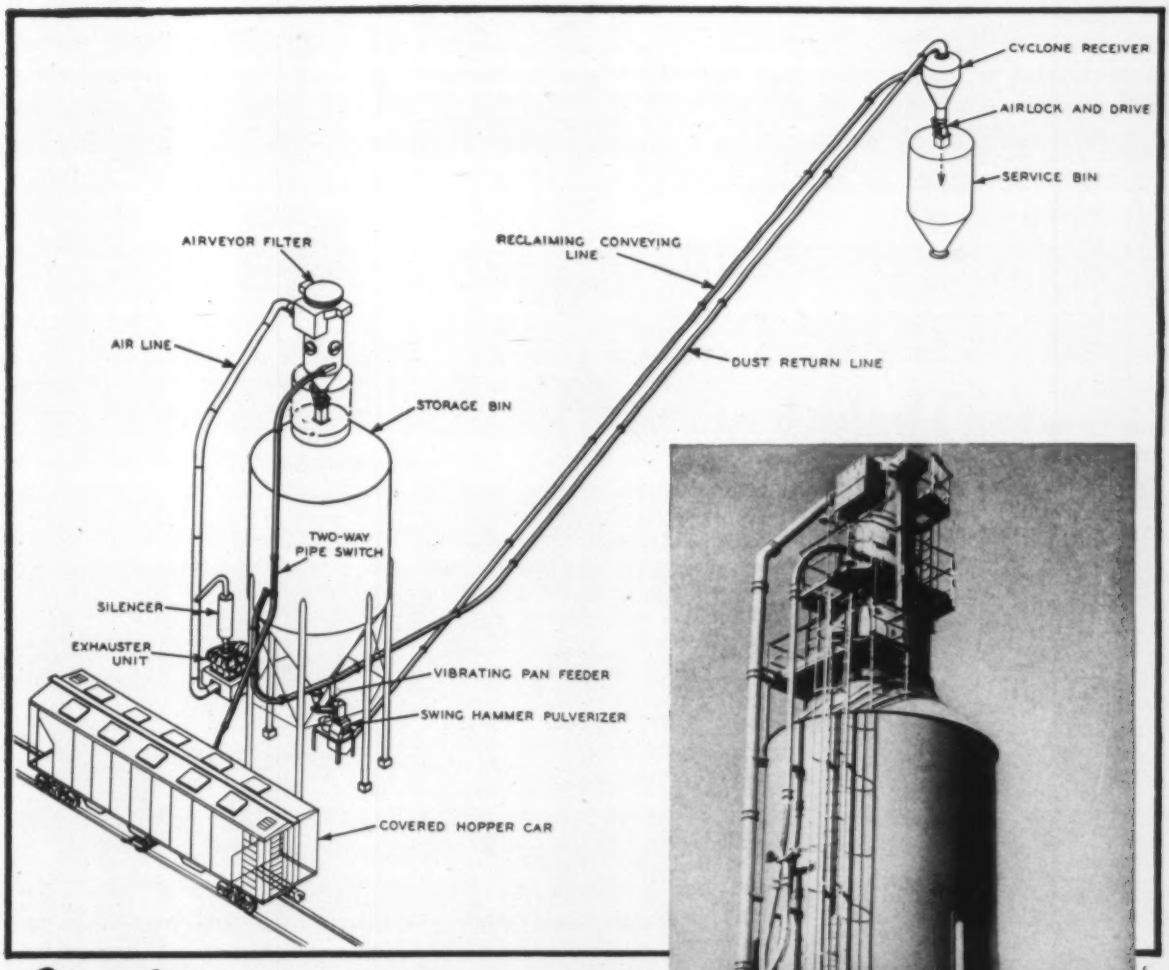
terminals. Line of switches includes three other models. **Tyniswitch Dept., Detroit Controls Corp.**, 800 Union Ave., Bridgeport, Conn.
—*Circle 474

Cam-Action Carrier

Item 475—

Automatic unit is capable of holding a wide variety of flat materials such as paper, cloth and light gage steel sheets. Cam-action carrier provides a special grip which will not mar surfaces or finishes. Applying a slight pres-

*For Inquiry Card, see page 17



Another "Blue Chip" company installs The AIRVEYOR®

Again, the Airveyor goes to work in the pulp and paper industry . . . this time for the $30 million, 350-ton bleached sulphate pulp and paperboard mill of the East Texas Pulp and Paper Company at Evadale, Texas.

The Airveyor unloads salt cake from either box or hopper-bottom cars, conveying to a main storage bin at rate of ten tons an hour. Also reclaims from storage and delivers to a service bin or feeder hopper above a mixing tank in the recovery building at rate of 8 tons an hour. One exhauster unit furnishes air for both unloading and reclaiming.

A second Airveyor system is also installed for the handling of wood chips received at the plant in trucks. Chips are discharged from a drag feeder to the Airveyor and conveyed a distance of 450 feet to storage at rate of 30 units an hour.

More than 150 Airveyor systems are in operation in the pulp and paper industry in the United States and Canada.

With over a quarter of a century of experience in air-conveying, Fuller engineers are well qualified to make a study of your problems and recommend equipment best suited to your needs. We will be glad to work with you.

FULLER COMPANY, 162 Bridge St., Catasauqua, Pa.

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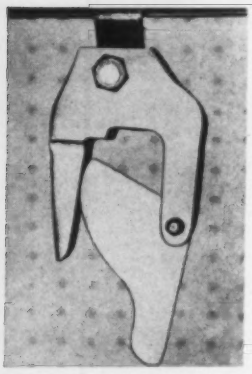
Fuller

. . . . pioneers in harnessing AIR



sure on the extension of the cam arm gives instant automatic or manual release. Up to 30 lb per single load can be gripped and carried. **Chainveyor Corp.**, 5618 East Washington Blvd., Los Angeles 22, Calif.
—*Circle 475

Trimming Potentiometers

Item 476—

Sub-miniature, precision wirewound trimming potentiometer with tabs for printed circuit applications. Unit features round or flat tabs in place of terminals to speed assembly with other circuit elements. Plugging device into printed circuit board, securing, and dip soldering completes assembly.

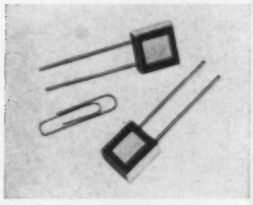
The potentiometers are sealed, moisture-proofed, anti-fungus treated, can withstand severe shock, vibration and acceleration. **Ace Electronics Associates Inc.**, 103 Dover St., Somerville 44, Mass.
—*Circle 476

Photocell

Item 477—

Suitable for direct operation of ac or dc relays, photocell will operate electronic trigger circuits at 1000 counts per second. Total encapsulation in resin makes unit moistureproof and shockproof. Photosensitivity is substantially independent of temperature from zero to 175F and decreases slightly as it approaches 212F.

Voltage rating is 120v ac or dc. The photocell operates as a non-

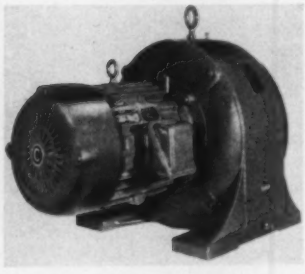


polar variable resistor, and the lowest sensitivity unit will pass 10 ma at 22.5v at 50 ft candles. Higher sensitivities are available. **Div. Hupp Corp., Hupp Electronics Co.**, 743 Circle Ave., Forest Park, Ill.
—*Circle 477

Gearmotors

Item 478—

Suitable for all slow-speed power applications, line of gearmotors is available in single, double and triple reduction with output speeds from 750 to 7.5 rpm. Unit comes with polyphase, single phase and dc motors. A variety of mounting positions are possible, including

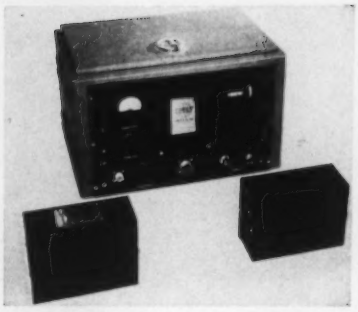


downshaft and tilted shaft. It is also available in open drip proof, dust proof, explosion proof and totally enclosed frames. **Century Electric Co.**, 1806 Pine St., St. Louis 3, Mo.
—*Circle 478

Photoelectric Detector

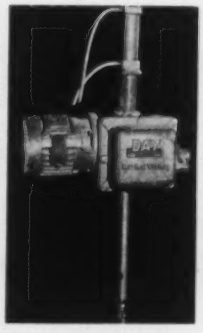
Item 479—

Instrument designed to detect light changes in the micro-lumen



range. It is applicable in the textile industry for detecting flaws, counting and maintaining quality control in yarn production. The operating sensitivity of the detector is adjustable within a wide range of light change limits to meet specific requirements.

Unit automatically detects variations in wire, vapor, webs or filaments of any materials, and a stop motion can be actuated. **Lindly & Co.**, Mineola, N.Y.
—*Circle 479



High Torque Unit

Item 480—

A package unit with motor drive and controls housed in a flange mounted sealed case, suitable for drilling, boring, tapping, counterboring, step drilling and other applications requiring high torque rotation.

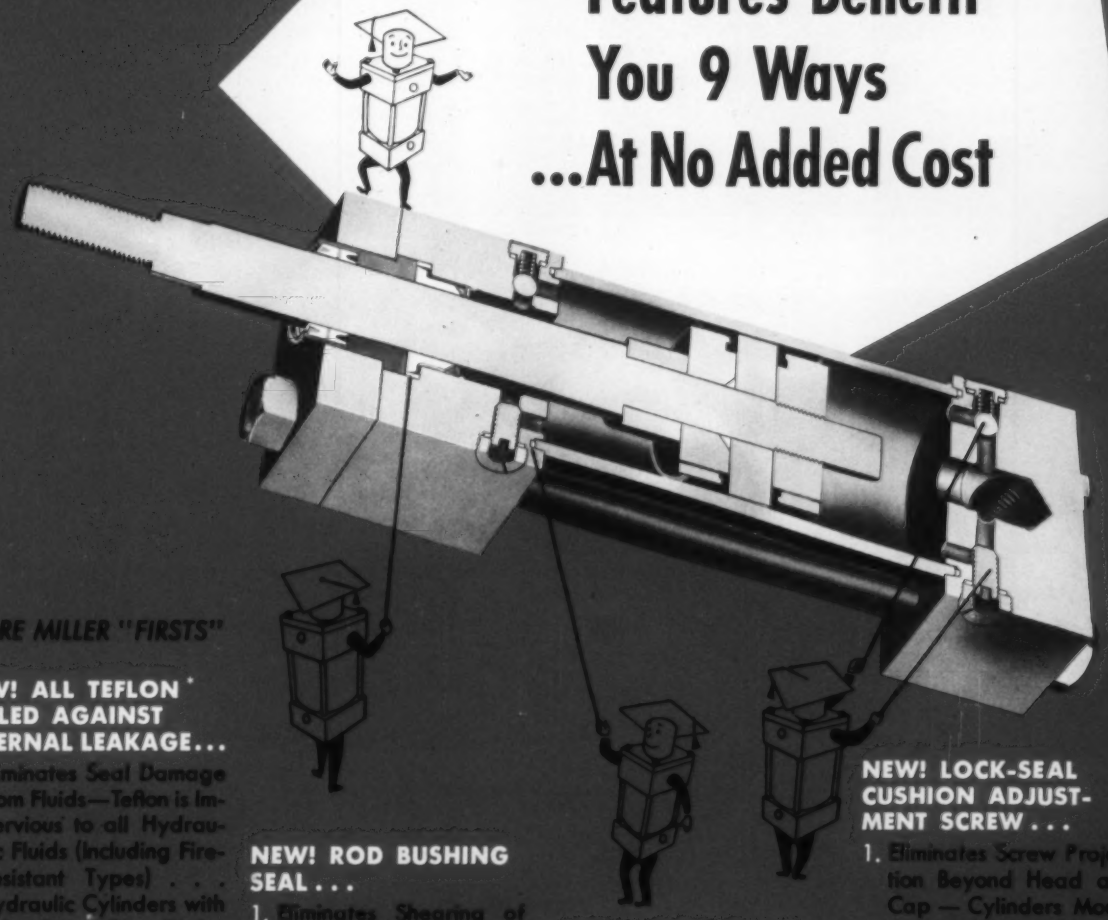
Entire cycle is automatic. Reversing mechanism counts revolutions, backs out tap and clears the piece.

Stroke and shaft lengths are available to suit requirements. Unit can be mounted in horizontal, angular and vertical positions. **George L. Day Co.**, 1227-31 Niagara St., Buffalo 13, N. Y.
—*Circle 480

*For Inquiry Card, see page 17

Circle 739 on Inquiry Card→

4 New Hydraulic Cylinder Features Benefit You 9 Ways ...At No Added Cost



MORE MILLER "FIRSTS"

NEW! ALL TEFLON* SEALED AGAINST EXTERNAL LEAKAGE...

1. Eliminates Seal Damage from Fluids—Teflon is impervious to all Hydraulic Fluids (including Fire-Resistant Types) . . . Hydraulic Cylinders with Teflon Piston Cups Slightly Higher.
2. Eliminates Seal Damage from High Temperatures—Teflon Sealed Cylinders Operate At —100° F. to 500° F.

NEW! ROD BUSHING SEAL . . .

1. Eliminates Shearing of "O" Ring in Re-Assembly
2. Eliminates Extrusion of "O" Ring at Extreme Pressures.

NEW! SHEF SEAL AT TUBING ENDS . . .

1. Eliminates Shearing of "O" Ring in Re-Assembly
2. Eliminates Extrusion of "O" Ring at *ANY* Pressure—Teflon Sealing Ring is Backed Up by Zero Clearance Metal Shoulder.

NEW! LOCK-SEAL CUSHION ADJUSTMENT SCREW . . .

1. Eliminates Screw Projection Beyond Head and Cap — Cylinders Mount on Any Side.
2. Eliminates Manual Sealing and Locking After Flow Adjustment—Teflon Seal is Self Regulating and Self Locking.
3. Eliminates Accessibility Problems—Cushion Screw Interchangeable with Ball Check Position—Adjustable Through Small Wrench Hole Drilled in Interfering Machinery.

*du Pont trademark for its tetrafluoroethylene resin.

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Turn Page For Cross Section Of SHEF SEAL

S SHEAR PROOF
H HEAT PROOF
E EXTRUSION PROOF
F FLUID PROOF
SEAL
Teflon Pressure Energized
Hydraulic Cylinder Tubing End Seal
PAT. APPLIED FOR

OTHER MILLER QUALITY FEATURES

- Case-Hardened Chrome Plated Piston Rod
- Rust Resistant Surfaces
- Teflon Oil and Dirt Wipers
- Interchangeable Square Design

Miller — FLUID POWER DIVISION
FLICK-REEDY CORPORATION

2015 N. Hawthorne Ave., Melrose Park, Ill.

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COUNTERBALANCE CYLINDERS • BOOSTERS

Miller®

Announces a New Space and Price Saving Hydraulic Cylinder Line

SAVE UP TO 76% OF COST

Heavy Duty Model LH—Same Size As Ordinary Gasket Type Square Design Low Pressure Cylinders

BORE	NORMAL RATINGS	NON-SHOCK INTERMITTENT RATINGS	YOU SAVE THIS % IN PRICE OVER STANDARD 2000-3000 PSI CYLINDERS
1½"	1500 PSI	2500 PSI	27%
2	1500	2500	27%
2½	1000	1500	28%
3¼	1500	2500	32%
4	1000	1500	35%
5	800	1200	37%
6	800	1200	43%
8	500	800	50%
10	500	800	71%
12	500	800	76%
14	500	800	*Not Available in 2000-3000 PSI*

MORE MILLER "FIRSTS"

Miller®

Announces 50% More Power Per Cylinder Dollar

with Extra Heavy Duty

3000-5000 PSI MODEL H

HYDRAULIC CYLINDERS

Same Price and Mounting Dimensions as Miller 2000-3000 PSI Hydraulic Cylinders.

BOTH LINES MADE POSSIBLE BY SHEF SEAL

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AIR AND HYDRAULIC CYLINDERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS • BOOSTERS

OTHER MILLER QUALITY FEATURES

- All Teflon Sealed Against External Leakage—Teflon Cups Extra
- Case-Hardened Chrome Plated Piston Rod
- Shear Proof Rod Bushing Seal
- Ball Check Interchangeable with Self Sealing and Locking Cushion Adjustment
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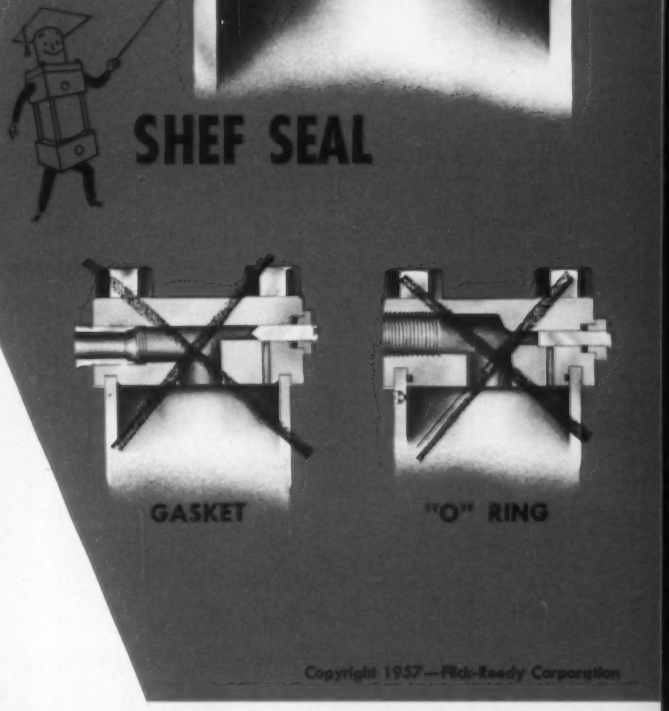
- Teflon Oil and Dirt Wipers

SHEF SEAL
S SHEAR PROOF
H HEAT PROOF
E EXTRUSION PROOF
F FLUID PROOF
SEAL
Teflon Pressure Energized
Hydraulic Cylinder Tubing End Seal
PAT. APPLIED FOR

SHEF SEAL Obsoletes All Other Hydraulic Cylinder End Seals . . . *at no added cost*

HAS EVERY ADVANTAGE

1. Pressure Energized—Sealing Effectiveness Increased with Pressure.
2. Zero Metal-To-Metal Clearance at all Pressures Gives You Perfect Seal Backup. Sealing Ring Cannot Extrude.
3. Simplified Servicing. No "Blind" Assembly. Sealing Ring Cannot Shear.
4. Teflon* Sealing Ring Withstands All Hydraulic Fluids at Temperatures from —100° F. to 500° F.
5. Head and Cap Axial Movement Does Not Destroy Sealing.
6. Allows Air Bleed In Head and Cap for Remote or Automatic Bleeding.
7. One Sealing Ring Cross Section Dimension For All Cylinder Sizes—Supplied On Convenient Spools.
8. Zero Metal Backup Clearance Eliminates Dangerous Leaks and Spurts of Fluid Due To Seal Failure.



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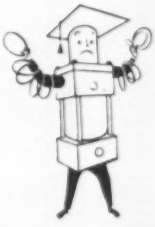
1. Unpredictable Results—Leaks and Blows Even at Low Pressures.
2. Outlawed by J.I.C. Eight Years Ago.
3. Seal Failure Causes Dangerous Leaks and Spurts of Fluid. Creates Unnecessary Fire and Safety Hazard.

"O" RING CONSTRUCTION

1. High Pressures and Shock Loads Expand Tubing—Increase Clearance and Cause Extrusion.
2. Blind Assembly Can Shear Sealing Ring—Difficult Servicing.
3. Seal Failure Causes Dangerous Leaks and Spurts of Fluid. Creates Unnecessary Fire and Safety Hazard.
4. Requires Large Inventory of "O" Rings
   —For Servicing Variety of Cylinder Bores.
   —For Special Synthetic Rubber Compounds To Meet Ever Changing Fluid and Temperature Needs.



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HAS EVERY ADVANTAGE...

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1. Impervious to Every Hydraulic Fluid Including Fire-Resistant Types.
2. Seals Perfectly in Cylinders at Temperatures from —100° F. to 500° F.
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4. With Proper Design of External Seal Cavities, Teflon Can Be Included *Without* Increasing Prices. Miller Provides Teflon for all External Seals at Prices Competitive with Ordinary Cylinders. Leather Internal Piston Cups are Standard (Teflon Cups Extra).

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of worry-free
Cylinder performance
...at competitive prices

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1. Unsatisfactory Except When Used With A Limited Range of Hydraulic Fluids.
2. Even Uncontrollable Changes in Fluid Additives Often Destroy Seal.
3. Specific Compounds Needed for Compatibility with Specific Fluids Normally Used Today.
4. Normal Temperature Range Limited to 0° F. to 130° F. Slightly Reduced Life When Operated at 130° F. to 150° F. Greatly Reduced Life at 150° F. to 250° F.
5. External Leakage Causes Fire and Safety Hazards When Temperature or Fluid Destroys Seals.
6. "U" Type Seals Without Mechanical Retainer at Mid-Section Frequently "Roll" and Lose All Sealing Ability.

Resin Impregnated Leather— As Dynamic Seals Only

1. Is Compatible with Many—But Not All—Hydraulic Fluids and Additives Including a few Fire-Resistant Types.
2. Normal Temperature Range Limited to —60° F. to 130° F. Slightly Reduced Life When Operated at 130° F. to 150° F. Substantially Reduced Life at 150° F. to 250° F.
3. External Leakage Causes Fire and Safety Hazards When Temperature or Fluid Destroys Seals.
   Miller Uses Leather Piston Cup Seals for Internal Sealing... Standard Price (Teflon Cups Extra).

Piston Rings— As Dynamic Internal Seals

1. Most Piston Rings Allow Some Leakage.
2. Allow "Slip" or "Drift" of Piston Due To Leakage—Unsatisfactory for Many Applications.
3. Allow Varying Feed Rates Due To Leakage Because Of Viscosity Change During Startup—Unsatisfactory for Most Multiple and Automated Operations.
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- Rust Resistant Surfaces
- Teflon Oil and Dirt Wipers

catalogs and literature

Latest automation information. For copies use card page 17.

566. Tap Drivers

Scully-Jones & Co., 1901 *S. Rockwell St., Chicago* 8, *Ill.*—10-*page bulletin*—Developed for reversible spindle machines, safe-torque tap drivers are the subject of Bulletin 20-50. Tension and compression, standard and quick-change drivers are illustrated; replacement parts are listed in chart form.—*Circle 566.

567. Combustion Safeguards

Selas Corp. of America, Dresher, Pa.—12-*page bulletin*—Used to extinguish flashback in mixture supply lines for heating equipment, or relieve excessive flashback pressure, line of automatic fire checks and safety blowouts is the subject of Bulletin SC-1006. Photographs, charts and graphs illustrate the bulletin.—*Circle 567.

568. Lubricating System

Farval Corp., 3249 *E. 80th St., Cleveland* 4, *O.*—8 *page bulletin*—Circulating oil system with built-in oil return is discussed in Bulletin #70. Valve operation and lubrication principles are described and illustrated, including a schematic diagram of the arrangement of system components.—*Circle 568.

569. Solenoid Volves

Skinner Electric Valve Div., Skinner Chuck Co., New Britain, Conn.—52-*page catalog*—Line of solenoid valves which include two, three and four-way types for use with air, inert gases, oils, hydraulic fluids, gasoline, etc. are described and illustrated in Catalog No. D1. Definition of terms, reference tables, electrical current and flow rate data are included.—*Circle 569.

570. Magnetic Tape Equipment

Ampex Corp., 934 *Charter St., Redwood City, Calif.*—16 *page booklet*—Application of magnetic tape instrumentation for data acquisition, data storage and transfer, time delay programing and machine tool control are among subjects discussed in booklet. Performance, techniques and systems are covered.—*Circle 570.

571. Motor Control Centers

Cutler-Hammer Inc., 315 *N. 12th St., Milwaukee* 1, *Wis.*—32 *page handbook*—Advantages of the modular design through complete standardization of units and simplified installation and changeability are discussed in Bulletin EL-174. Detailed information on various units is given. Numerous illustrations and drawings are included, plus a chart of how to plan a Unitrol center.—*Circle 571.

572. Small Industrial Pumps

Tuthill Pump Co., 939 *E. 95th St., Chicago* 19, *Ill.*—12-*page bulletin*—Used in lubricating, hydraulic, transfer, circulating and burning oil services, Model L series small industrial pumps are the subject of Catalog No. 101. Dimension and parts diagrams are included; performance curves are also shown.—*Circle 572.

573. Handling Systems

Planet Corp., 1800 *Sunset Ave., Lansing, Mich.*—16 *page booklet*—Ideas and data for solving materials handling problems are discussed in Bulletin 67A. Engineering service is explained and automated production applications described and illustrated.—*Circle 573.

574. Steel Conveyors

Visi-trol Engineering Co., 9345 *Hubbell, Detroit* 28, *Mich.*—4-*page pamphlet*—Construction details, sizes, travel speeds, working heights, and load capacities are described in Bulletin No. C-1056. Operating features of the Conveymatic Carrousel steel platen conveyors such as automatic indexing are discussed.—*Circle 574.

575. Proximity Switch

Micro Switch Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill.—2 *page pamphlet*—Advantages of magnetic device with no moving parts are discussed in Bulletin 130. Installation diagram and performance specifications are given.—*Circle 575.

576. Industrial Trucks

Baker-Raulang Co., Box 5579, *Cleveland* 1, *O.*—12 *page bulletin*—Battery powered and gasoline powered fork trucks are among models described and illustrated in Bulletin 57. Data on construction features and special attachments are included.—*Circle 576.

577. Pilot Operated Valves

A. W. Cash Co., P.O. Box 551, *Decatur, Ill.*—4-*page bulletin*—Designed for accurate pressure control of steam under varying load conditions, Type 44 single seat, pilot operated pressure reducing and regulating valve is the subject of Bulletin 981. Photograph, diagram, specifications and capacity chart are included.—*Circle 577.

578. Automatic Butt Splicer

Champlain Co. Inc., 88 *Llewellyn Ave., Bloomfield, N. J.*—2-*page pamphlet*—Designed for in-line operation with roll fed presses, automatic butt splicer which splices a new web of paperboard onto an expiring web is discussed in bulletin. Photographs and sketch illustrate the text.—*Circle 578.

*For Inquiry Card, see page 17

579. Pneumatic Control

The Bristol Co., Waterbury 20, *Conn.*—44 *page catalog*—The basic concepts of narrow band, proportional, reset, derivative and reset plus derivative control actions are discussed. Bulletin A130 includes a section on the general automatic control theory. The line of pneumatic recording and indicating controllers is also described.—*Circle 579.

580. Contour Mill

Colonial-Romulus Div., Colonial Broach & Machine Co., Parkgrove Station, Detroit 5, *Mich.*—4-*page pamphlet*—Featuring hydraulic actuation and control, Hydro-Cycle contour mill is the subject of Bulletin No. CRH-57. Application photographs and specifications of the hand-guided tracer machine are included.—*Circle 580.

581. Indexing Machines

Hartford Special Machinery Co., Hartford, Conn.—8 *page bulletin*—Specifications on standard components for the 65-inch horizontal indexing machine are given. Self-contained components for quick assembly are described and illustrated.—*Circle 581.

582. Process Refractometer

Consolidated Electrodynamics Corp., 300 *N. Sierra Madre Villa, Pasadena, Calif.*—8-*page bulletin*—Developed for monitoring and control of petroleum and chemical processes, Type 38-202 process refractometer is the subject of Bulletin 1833. Discussion of the unit and its application to fractionator control and blending control is included.—*Circle 582.

583. Automatic Assembly

Dixon Automatic Tool Inc., 2300-23*rd Ave., Rockford, Ill.*—4 *page pamphlet*—Standardized units that can be combined with existing equipment to automate small parts assembly operations are the subjects discussed in Bulletin B-1. Details on an automatic screw driver for handling nuts and screws up to 5/16-inch thread size, data on standardized adjustable machine bases and various brackets to simplify mounting pieces of assembly equipment are given.—*Circle 583.

584. Pressure Control Valves

Milton Roy Co., 1300 *E. Mermaid Lane, Philadelphia* 18, *Pa.*—4 *page pamphlet*—Complete specifications, capacities and dimensions for chemical relief valves and back pressure valves are included in Bulletin 357. Tables on materials of construction are also given.—*Circle 584.

585. Automatic Packaging

Pneumatic Scale Corp. Ltd., Quincy 71, *Mass.*—16 *page booklet*—Various types of automatic packaging machines designed to run at speeds ranging up to 300 containers per minute are described and illustrated in Bulletin 133. This includes range, speed and weight data. Floor plans of machines combinations are also shown.—*Circle 585.

586. Air/Hydraulic Hints

Logansport Machine Co. Inc., Logansport, Ind.—18 *page booklet*—"Facts of Life" booklet gives pointers for installation and servicing of hydraulic and pneumatic systems. Do's and don'ts on the operation and maintenance of power units, valves, lines, cylinders, and other equipment are included.—*Circle 586.

587. Tape Recorder

Minnesota Mining and Manufacturing Co., 900 *Bush St., St. Paul* 6,

*For Inquiry Card, see page 17

Minn.—40 *page catalog*—Use and advantage of tape recorders in management communication; methods and procedures in factories; in personnel and sales departments is discussed. A table listing the reel size and playing time of the various tapes is included.—*Circle 587.

588. Electrical Connectors

Cannon Electric Co., 3208 *Humboldt St., Los Angeles* 31, *Calif.*—32 *page catalog*—Data on plugs and receptacles for power connectors, battery connectors and heavy duty connectors is given in Bulletin GB6. Industrial and allied applications are described.—*Circle 588.

589. Relays

Magnecraft Electric Co., 3354D *West Grand Ave., Chicago* 51, *Ill.*—16 *page booklet*—Printed circuit relays, power relays and snap action relays are among units described in Catalog 157. Standard coil data chart and relay contact code are included.—*Circle 589.

590. Weight Control Systems

Industrial Nucleonics Corp., 1205 *Chesapeake Ave., Columbus* 12, *O.*—12-*page bulletin*—Used to automatically measure and control basis weight of bond, publication, glassine, newsprint, and asbestos papers, process control systems are discussed in Bulletin #B-1657. Application photographs also illustrate the system being used on paper converting lines.—*Circle 590.

591. Temperature Control

Barber-Colman Co., 1400 *Rock St., Rockford, Ill.*—8-*page bulletin*—Functions, uses and advantages of centralized automatic temperature control with visual supervision of the entire heating and air conditioning system are covered in Booklet F 8031. Schematic drawings, photographs and specifications of the Electronic control centers are included.—*Circle 591.

592. Hydraulic Cylinders

Vickers Inc., Div., Sperry Rand Corp., Detroit 32, *Mich.*—10-*page bulletin*—Detailed information on the construction and features of Vickers 2000 psi cylinders, including the new trunnion-mounted types, is covered in Bulletin No. 57-68. Tables of sizes and dimensions and useful engineering data on application, mounting, piston areas and speeds are also included.—*Circle 592.

593. Tape Wound Cores

Magnetics Inc., Butler, Pa. — 28 *page handbook*—A section suitable for use as a design manual for specifying tape wound cores is included in Bulletin TWC-200. Advantages, performance and specifications of company produced tape wound cores are given.—*Circle 593.

594. Variable Speed Drives

Magnetic Amplifiers Inc., 632 *Tinton Ave., New York* 55, *N. Y.*—4 *page pamphlet*—General specifications, engineering data and operational features are given for fractional horsepower drives rated ⅛ or 1/15 hp.—*Circle 594.

595. Metal Hose & Tubing

American Metal Hose Div. American Brass Co., Waterbury 20, *Conn.*—60 *page catalog*—Types, sizes, engineering specifications, uses and construction are discussed in Catalog G560. A section describing flexible metal hose and tubing for uses such as coin chutes and hot and cold air ducts is also given. Advantages of seamless, corrugated and stripwound metal hose are included. Numerous

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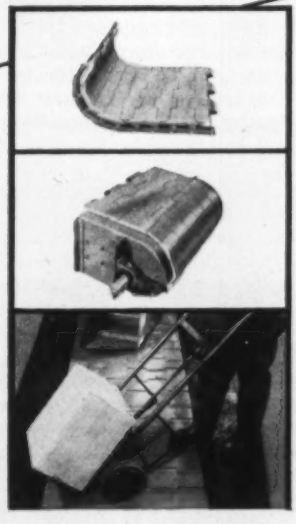
MOVING "SIDEWALK" WILL HANDLE WIDE RANGE OF MATERIALS



May-Fran proudly announces a new concept in materials handling . . . the May-Fran FLAT-TOP steel conveyor belt. Precision-forged steel plates interlock snugly to form a rugged, flat-surfaced conveyor belt ideal for assembling appliances, automobiles and other types of heavy products or for handling hot, heavy or rough materials. Special May-Fran link design forges the entire belt into a rugged, integral unit capable of negotiating either *concave* or *convex* curves—yet permits rapid assembly or disassembly.

Designed especially for flush-with-floor as well as extended surface mountings involving heavy-duty operations, the FLAT-TOP steel conveyor has no stationary or moving parts above the surface of the belt. In floor mounted applications, there are no aisle obstructions to disrupt normal plant traffic . . . employees and mobile equipment can safely cross the FLAT-TOP belt while it is moving. This special flat-deck design also permits the handling of materials that extend beyond the width of the belt.

The May-Fran FLAT-TOP is specifically engineered to provide all the advantages of old-fashioned slat-type belting while eliminating the disadvantages and safety hazards common to slat conveyors. Tightly meshed belt links prevent tools and small assembly parts from falling through the belt.

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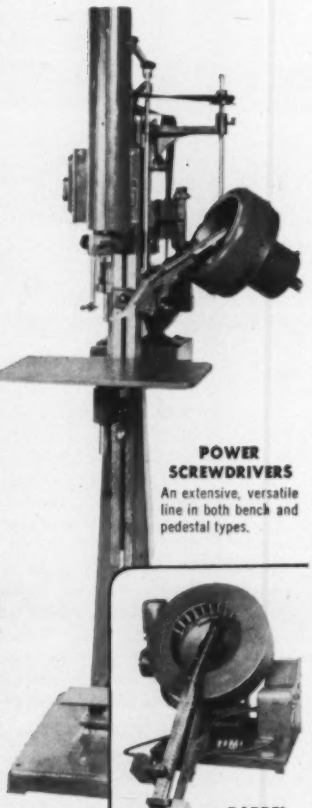

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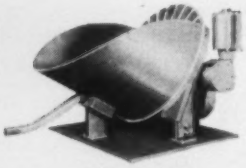
Electrical vibratory type to feed parts that cannot be tumbled.



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with stationary ring cover for heavy-duty production.

BARREL FEEDER
Popular motorized type, for parts requiring critical selection.

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diagrams and illustrations are shown. —*circle 595.

596. Pneumatic Control

Leeds & Northrup Co., 4934 *Stenton Ave., Philadelphia* 44, *Pa.*—12 *page bulletin*—Data on pneumatic controllers for steel, chemical, petroleum and allied industries are given in Bulletin ND4(9). Illustrations of construction details and optional equipment are included.—*Circle 596.

597. Tube Fittings

The Weatherhead Co., Customer Service Dept., 128 *W. Washington Blvd., Fort Wayne, Ind.*—48 *page catalog*—All sizes and types of brass fittings are listed. Push-pull controls and complete assembly instructions on fittings are given. A section showing the complete line of drain and shutoff cocks is also included.—*Circle 597.

598. Continuous Wheel Dresser

Koebel Diamond Tool Co., 9456 *Grinnell, Detroit* 13, *Mich.*—6 *page pamphlet*—Continuous form control of grinding wheels using cutters of cemented diamond particles is described in Bulletin LO-5709. Schematic drawings and illustrations are included.—*Circle 598.

599. Heavy Duty Relays

Arrow-Hart & Hegeman Electric Co., Industrial Control Div., 103 *Hawthorn St., Hartford* 6, *Conn.*—8 *page bulletin*—Plug-in and latching type relays are described. Installation instructions and illustrations are given. Catalog data and ordering information are also included.—*Circle 599.

600. Rotary Feeder

Allen-Sherman-Hoff Co., 259 *E. Lancaster Ave., Wynnewood, Pa.*—6-*page pamphlet*—Developed for heavy duty materials handling applications, Type B rotary feeder for dry, free-flowing materials is described in Data Sheet DVc. Photographs and cutaway drawings of various components illustrate design and construction of the feeder; tables of sizes and capacities are included.—*Circle 600.

601. Instrument Air Filters

Air-Maze Corp., 25000 *Miles Rd., Cleveland* 28, *O.*—2-*page pamphlet*—Designed to remove fine dirt particles and entrained liquid droplets from

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compressed air streams, instrument air filters are the subject of Bulletin IAF-856. Filter elements, dimensions and weights of the air filters are covered.—*Circle 601.

602. Belt Conveyor Idlers

C. O. Bartlett & Snow Co., 6200 Harvard Ave., Cleveland 5, Ohio—7 page pamphlet—Complete line of belt conveyor idlers is covered. Construction details, sizes, dimensions, and weights are given. Accessories for belt conveyors are illustrated and described.—*Circle 602.

603. Equipment Builder

Food Machinery and Chemical Corp., San Jose, Calif.—32 page handbook—Processing, packaging and material handling equipment is included in the variety of items produced by various divisions of the company discussed in booklet "Putting Ideas to Work." Photographs of several industrial installations are included.—*Circle 603.

604. Tube Characteristics

Electronic Components Div., General Electric Co., One River Rd., Schenectady 5, N. Y.—228 page catalog—Ratings, characteristics, and configurations of receiving, special-purpose and television picture tubes of 1593 types are contained in revised seventh edition of "Essential Characteristics." Basing diagrams and typical circuits are shown.—*Circle 604.

605. Load Tap Changing Units

Moloney Electric Co., 4565 Emerson St., St. Louis 20, Mo.—30 page handbook — Application, operating principles, external and internal construction of tap changing units for voltage control are covered in Bulletin LTC-2907. Numerous illustrations and drawings are included.—*Circle 605.

606. Electric Controls

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.—132-page catalog—Comprehensive line which includes magnetic starters, drum switches, limit switches, relays, rheostats, pushbuttons, solenoids and special control devices is described in the seventh edition of the Handy Catalog. Photographs, specifications and price data on each type of unit are given. Multi-unit control centers

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Variable speed and overload protection. Sizes 250, 500 up to 1500# pulling capacity. Loads up to 30 times these ratings can be conveyed.
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DEVILBISS HELPS YOU GET THE *MOST* FROM THE SPRAY METHOD

designed to provide centralized mounting of controls for a number of motors are described and illustrated.—*Circle 606.

607. Molding Presses

F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.—12 page bulletin—Data on new series of automatic compression molding presses is given in Bulletin 200. Specifications for models of 50, 75, 125 and 200 tons capacity are also included.—*Circle 607.

608. Tube Fittings

Tube and Hose Fittings Div., Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio—28 page catalog—Specifications for line of flareless tube fittings are given in Catalog 4320. Pipe thread and straight thread elbows, tees and connectors are among items described.—*Circle 608.

609. Motor Speed Controls

Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.—16 page booklet—Supercalender drives, winder drives, co-ordinated drives and AV packaged drives described in Bulletin B-4038-A illustrate uses of drive equipment controlled by magnetic amplifier regulators. Controls for register regulation and equipment for maintaining even edges on rolls are also illustrated.—*Circle 609.

610. Air Hoists and Cylinders

Pneumatic Div., Curtis Mfg. Co., 1918 Kienlen Ave., St. Louis 20, Mo.—12 page bulletin—Features of line of air hoists, cylinders and valves are described in Bulletin A-4-C. Approximate dimensions and capacities of units are included.—*Circle 610.

611. Conveyor Systems

Jervis B. Webb Co., 8951 Alpine Ave., Detroit 4, Mich.—16-page booklet—Various material handling applications described and diagrammed include dispatching of materials automatically; storing, indexing, and recirculating of loads. Illustrations of conveyor installations are included.—*Circle 611.

612. Card Controlled Lathe

Sundstrand Machine Tool Co., 2531 11th St., Rockford, Ill.—6-page pamphlet—Designed primarily for parallel motions, Model 14 production lathe with punch card controls is dis-

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cussed in illustrated pamphlet. Principle of operation is explained and photograph of the lathe is included.—*circle 612.

613. Flexible Metal Hose

Universal Metal Hose Co., 2133 *S. Kedzie Ave., Chicago* 23, *Ill.*—10 *page bulletin*—Types of hose are described and illustrated including the seamless and interlocked types and the styles of couplings used for each. Bulletin ID-100A gives the recommended pressures, temperatures and specific uses for which each type is suited.—*Circle 613.

614. Electrical Connectors

Deutsch Co., 7000 *Avalon Blvd., Los Angeles* 3, *Calif.*—24 *page catalog*—Construction and operational features of line of miniature electrical connectors are described. Various types of plugs and receptacles are illustrated and clocking charts given that show contacts and alternate insert positions.—*Circle 614.

615. Control Centers

Square D Co., 4041 *N. Richards St., Milwaukee* 12, *Wis.*—16 *page booklet*—Advantages and features of company's control centers are described and illustrated. Specification charts are included and information sheets to organize plans can be obtained.—*Circle 615.

616. Press Room Equipment

Sesco Inc., 8881 *Central Ave., Detroit* 4, *Mich.*—16 *page booklet*—Punch press feeding machines, power driven straighteners and centering reels are among items discussed. A description and detailed drawing of the hydraulic system for a gripper feed is also included.—*Circle 616.

617. Speed Reducers

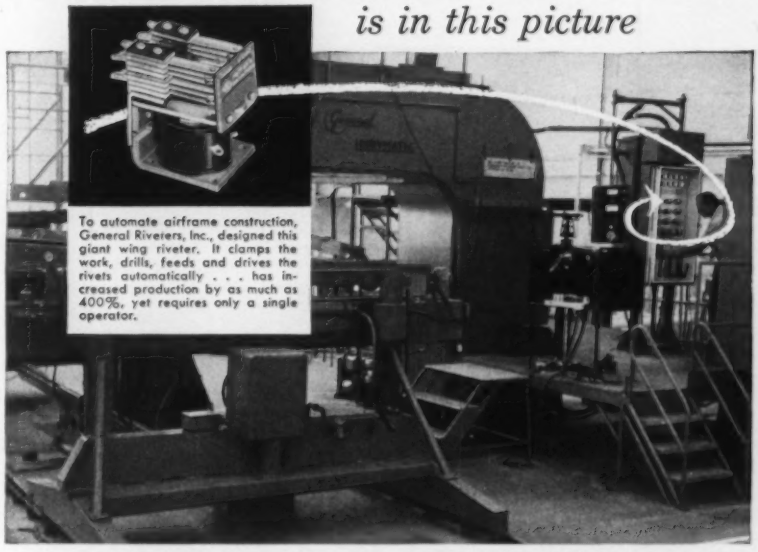
Falk Corp., Dept. 255, 3001 *W. Canal St., Milwaukee* 1, *Wis.*—24-*page catalog*—Suitable for applications requiring gear drives in the range from 400 to 70,000 lb-inch output torque, line of offset shaft, concentric shaft and right angle speed reducers is the subject of Bulletin 1105. Horsepower and torque ratings are given; application photos, overhung load and thrust capacities are also included.—*Circle 617.

618. Plunger Relays

Ebert Electronics Corp., 212-26

*For Inquiry Card, see page 17

Potter & Brumfield *engineering is in this picture*



To automate airframe construction, General Riveters, Inc., designed this giant wing riveter. It clamps the work, drills, feeds and drives the rivets automatically . . . has increased production by as much as 400%, yet requires only a single operator.

P&B RELAYS AUTOMATE THIS GIANT RIVETER *for New Lockheed Electra Wings...*

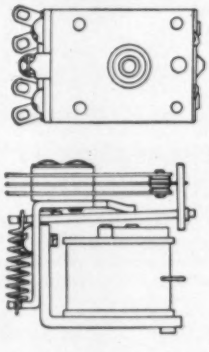
This new automatic riveter will be used to make wings for the new Lockheed Electra, a prop-jet luxury liner, as well as many other modern aircraft. The heart of this riveter is a relay circuit that "takes orders" from a pattern of holes punched in 35 mm film strips.

General Riveters, Inc. selected the GA Series P&B relay for the control circuits of this riveter because of its unusual dependability and versatility. In adapting this relay to a specific application, P&B's engineers again demonstrate how 25 years of creative engineering can pay off by providing a standard type or completely new relay to solve your particular problem. Write today for new compact catalog or engineering consultation.

P&B Standard Relays are available at your local electronic, electrical and refrigeration distributors

ENGINEERING DATA GA SERIES RELAY

Multiple Leaf AC or DC



CONTACTS
Material: 3/16" fine silver (other contact materials can be furnished for specific applications)
Rating: 5 amp. 115 V. 60c non-inductive load
Arrangements: 4 Form C Max., AC, 6 Form C Max., DC
Breakdown: 1000 V. RMS between all elements

COIL
Resistance: 30,000 ohms max.
Power Req'd: 6 W. max., 2 W. min. DC at 25° C. ambient
V range: DC to 110 V.; AC to 230 V.

DIMENSIONS, MAX.
1-23/32" L. x 1-1/16" W. x 1-25/32" H.

MOUNTING DATA 4 tapped #6-32 holes, .750" x .875" o.c.; 1 tapped #8-32 core

ENCLOSURES Hermetically sealed, octal plug: 2-17/32" x 1-29/32" x 1-25/32"
Multiple solder header and miniature plug-in: 2-15/32" x 1-29/32" x 1-25/32"
Special container required for 6 Form C

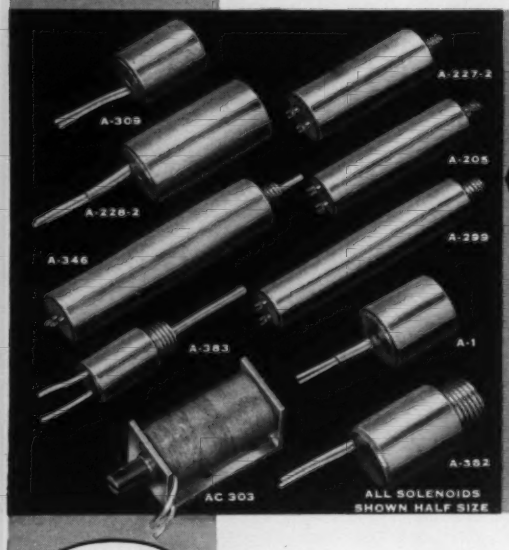
TERMINALS Contacts: two #16 AWG wires
Coil: two #20 AWG wires

Potter & Brumfield, inc.

See our catalog in Sweet's Product Design File

PRINCETON, INDIANA *Subsidiary of* AMERICAN MACHINE & FOUNDRY COMPANY
Manufacturing Divisions also in Franklin, Ky. and Laconia, N. H.

WesCo miniature solenoids...



do big jobs in small space

- Completely tested
- Proven reliable
- Mounting furnished to meet your requirements.
- **Hundreds of other designs** for both AC and DC application.
- Push or pull units to 200 lbs. force.
- Send your specifications today.

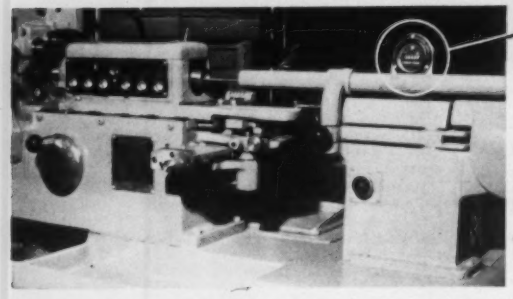
WesCo *The trademark on millions of solenoids since 1927*

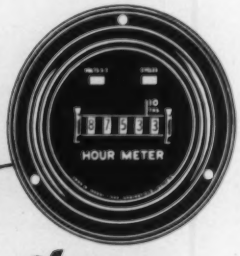
WEST COAST ELECTRICAL MFG. CORP.

233 W. 116TH PLACE • DIVISION 122 • LOS ANGELES 61, CALIFORNIA • PLymouth 5-1138

Circle 709 on Inquiry Card

AUTOMATION REQUIRES GREATER EMPHASIS ON PROTECTIVE MAINTENANCE





Hobbs **HOUR METERS**

TAKE AWAY THE GUESSWORK!

The Hobbs AC Hour Meter indicates operating time of any machine or equipment powered by alternating current — basic time data essential in the study of utilization and production methods . . . and vital for protective maintenance programs. Wide range of applications — small, compact, easy to install. Ruggedly built and sealed against moisture and dust. Powered by an accurate synchronous motor specially designed for this instrument. Easy to read — tells at a glance accumulated time of operation to 10,000 hours, showing 1/10th hours. Also available in 100,000 hour models.

● **Ask your supplier . . . or write direct for Catalog AC-587 with complete information.**

JOHN W. *Hobbs* CORPORATION — A DIVISION OF STEWART SW WARNER

2080 YALE BLVD. SPRINGFIELD, ILLINOIS

Circle 710 on Inquiry Card

Jamaica Ave., Queens Village 28, *N. Y.—4-page pamphlet*—Detailed information on plunger type mercury relays is given in Catalog 154. Operational features, construction, characteristics and load ratings are included.—*Circle 618.

619. Steel Belt Conveyor

Sandvik Steel Belt Conveyors Div., Sandvik Steel Inc., 1702 Nevins Rd., Fair Lawn, N. J.—2 page pamphlet—Operation and advantages of steel belts conveyors with V-ropes bonded on inner surface for traction and alignment are explained. Illustrations of various conveyor applications are included.—Circle 619.

620. Bronze & Steel Valves

Manning, Maxwell & Moore Inc., Stratford, Conn. — 80-page catalog—Applicable to power, petroleum, chemical and general industrial installations, line of bronze and steel valves is described in catalog. Material specifications, flow charts, temperature and pressure ratings are included. Valve designs include globe, angle, gate and Flocontrol.—*Circle 620.

621. Pneumatic Devices

Industrial Div., Watts Regulator Co., Lawrence, Mass.—4-page pamphlet—Air filters, regulators and lubricators available singly and in combination are discussed and illustrated in Folder F-15B. Photographs and specifications of several models are included; data on air relief valves, strainers and accessories are also given.—*Circle 621.

622. Screw Conveyors

Link-Belt Co., Dept. PR, Prudential Plaza, Chicago 1, *Ill.—6-page pamphlet*—Designed to fit new or existing screw conveyors, line of ball bearing components is described in Folder No. 2489. Single and double ball bearing trough ends, ball bearing hangers, conveyor screws, ball and roller bearing enclosed countershaft ends and single reduction Motogear units are covered. Specification data are included in chart form.—*Circle 622.

623. Production Furnaces

Hevi-Duty Electric Co., Milwaukee 1, *Wis.—4-page pamphlet*—Line of conveyor and pusher furnaces with temperature ranges from 400 to 2600F is discussed and illustrated in

For Inquiry Card, see page 17

Bulletin 357. Furnaces are designed for continuous production and precise control. Eight models are illustrated and briefly described—*Circle 623.

624. Open Back Presses

Federal Press Co., Elkhart, Ind.—20-page booklet—Used for drawing, piercing, crimping, etc., dial feed presses are included in line which is illustrated in booklet. Standard geared and flywheel types of open back inclinable presses are also illustrated, with specifications for models from 6.6 to 100-ton capacity. —*Circle 624

625. AC-DC Relays

RBM Div., Essex Wire Corp., Logansport, Ind.—8-page bulletin—Used for circuit switching or electrical interlocking and remote control of air conditioning, lighting and single-phase motor loads, etc., line of general purpose ac and dc relays is the subject of Bulletin No. 1060. Contact construction, arrangements and ratings are charted; application data and photographs are also included. —*Circle 625.

626. Spray Finish Machine

DeVilbiss Co., Toledo 1, O.—12-page bulletin—Basic types of automatic transverse spray finishing machines are covered and illustrated in this catalog. Specifications of horizontal and vertical, straight line and contour types are included, along with typical uses.—*Circle 626.

627. Handling Systems

Jervis B. Webb Co., 8951 Alpine Ave., Detroit 4, Mich.—41-page catalog—Material covering in detail the design, features and applications of the in-floor Towveyor and overhead Tow-Conveyor systems are presented in this catalog. Mechanical details are explained for every component part of both types of conveyor systems.—*Circle 627.

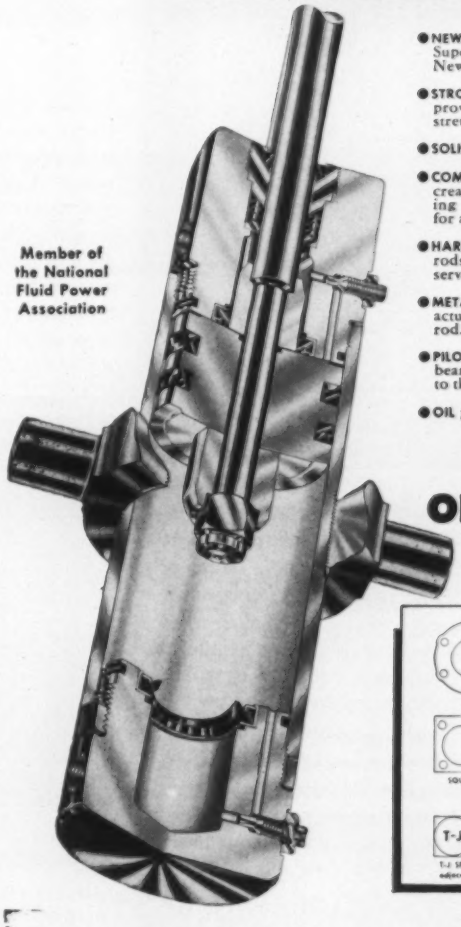
628. Piezoelectric Transducers

Endevco Corp., 161 E. California St., Pasadena, Calif.—12-page bulletin —Used in accelerometers, pressure pickups, and force gages, piezoelectric transducers are the subject of Bulletin 2.31. General applications of the transducers are covered, using charts and curves to indicate characteristics and limitations.—*Circle 628.

*For Inquiry Card, see page 17

all the EXTRAS are standard with

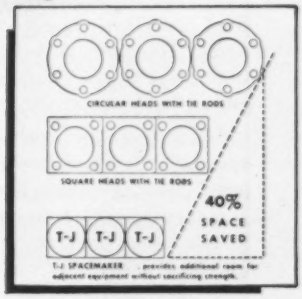
T-J Spacemaker CYLINDERS



Member of the National Fluid Power Association

- NEW *exclusive* ingenious cushion designs . . . Super Cushion Flexible Seals for Air . . . New Self-Aligning Master Cushion for Oil.
- STRONGER than outmoded tie rod design, proven through actual tests. No tie rods to stretch.
- SOLID STEEL HEADS throughout the full line.
- COMPACT DESIGN eliminates tie rods, increasing the strength and reducing mounting space required, providing extra room for adjacent equipment.
- HARD CHROME PLATED body bores and piston rods . . . assure you of long trouble-free service. (Standard at no extra cost.)
- METALLIC ROD SCRAPER, not just a wiper, actually removes foreign matter from the rod.
- PILOTED PACKING GLAND with extra long bearing. Additional strength and support to the piston rod.
- OIL pressure to 750 p.s.i. AIR to 200 p.s.i.

DELIVERY OFF THE SHELF!



You *save 40% space* when you switch from outmoded tie rod cylinders to the T-J Spacemaker! It's stronger, too! Fits right into automation programs in countless plants. Delivers top performance and dependability with a big *plus* in advanced features. Wide range of styles, capacities . . . reduces man-hours and costs in all kinds of push-pull-lift jobs. Off-shelf delivery in 64,000 combinations!

NEW LITERATURE—Send today for new Catalog SM56 with complete engineering details on Spacemaker line. Write The Tomkins-Johnson Co., Jackson, Mich.

T-J TOMKINS-JOHNSON
RIVETORS. AIR AND HYDRAULIC CYLINDERS. CUTTERS. CLINCHORS.

(Advertisement)

What good is specialized business

No one is in a better position to give a hard-boiled, practical answer to this question than the men who spend their working lives on the sales front... the men the ads are supposed to help... the men who sell.

Here are the statements of salesmen who know what advertising does for them when it appears in the industrial, trade or professional publications that serve the specialized markets to which they sell:

William F. Mattes, Jr.
Lamp Division,
General Electric

Sells retailers

Says Mr. Mattes: "My selling is mostly with the headquarters offices of chains—variety stores and food stores. Matter of fact, some of these chains, particularly in the variety store field, do not permit salesmen to call on store managers. They prefer to interview sales people at headquarters, and then send out mimeographed letters to their districts and store managers.

"This makes our trade ads doubly important—they have to take the place of salesmen with the individual store manager or department manager; and they add color and pictures and enthusiasm to the letters that are passed down from headquarters.

"In the old days, the idea of trade paper advertising would simply be to say: 'Stock General Electric lamps, they have the best customer preference.' Today the tendency is to be more specific, to show pictures of the product, illustrations of displays, and pertinent merchandising information. For instance, it is a good merchandising service to be able to tell chain retailers the proportionate popularity of different size bulbs, different colors and types, so that the best merchandising effort is made on the fast selling items. Any facts like these in our trade advertising help the chain store managers and so, of course, make our sales effort that much easier and more productive.

"Trade advertising very definitely helped us introduce and sell packaged light bulbs. Half our unit sales come in bulbs in the 25 to 100 watt range. Knowing this, we put these popular sizes in a handy 4-bulb package. Merchandising bulbs in packages was quite a revolutionary idea when we first introduced them ten years ago, and trade advertising was used to help sell the idea to store managers. Of course, some variety stores still sell loose bulbs, but more and more the trend is toward packaged sales."

Chester Burt
American Hard
Rubber Co.

Sells industry

Says Mr. Burt: "After some years as an inside man at American Hard Rubber, I'm taking on my first sales territory and believe me, I'd be worried if I didn't have good leads from our business paper advertising. They give me something to latch on to. With an advertising lead as a start I find there's a better possibility of something coming from a call than if I made a cold call.

"For one thing, even if the man who sent in the inquiry isn't in a very important position in the company, at least the inquiry gets me through the door and once I'm inside I can work it out.

"Another thing I've found is that I can do a better job of planning my trips if I have some advertising leads. More worthwhile calls can be scheduled and it's possible to accumulate leads

publication advertising?

to make a profitable trip to out-of-the-way areas. Of course, on top of all this, I think that in many cases where I've gotten business, trade advertising has reached some of the people inside that I can't see; like people who leave it to others to interview salesmen, but still have to give the final okay themselves."

Robert E. Furer
Mead Johnson & Company

Sells physicians

Says Mr. Furer: "I know that our journal advertising gets a message to the physicians I call on. Here's an example.

"Just the first of this year we adopted the Mead Johnson slogan, *'Symbol of Service in Medicine'*. Last week when working in New Haven, I had three physicians say to me, 'How is the Symbol of Service in Medicine today?'. They did not get the slogan from me. They must have had their thoughts jell from our advertisements in the ethical specialty journals.

"One very important thing is I know our advertising is selling items for me when that item is not on our list of products to push for the current period. For instance, Sustagen is a hot product we have in our line and it's not on our list this quarter. I love the product. It helps people be well fed and stay on the job. But this quarter my instructions are to put major effort on other items. Every time I'm tempted to deviate from the program and go after the big dollar-volume potential of Sustagen sales, I'm reassured that because of our advertising in the journals it is not being forgotten by my doctor friends. Man, this kind of help keeps you on the ball and helps me utilize the three to five minutes of face-to-face selling I have available to me with my doctor friends."

Frank Kistenberger
Metallizing Engineering Co., Inc.

Sells industry

Says Mr. Kistenberger: "I happen to know that better than 50% of my sales to new companies can be traced to leads from our business paper advertising. Another 25% of my sales to new owners I close after following up leads that can't be traced directly to our advertising, but I know darn well that that's where they come from because that's about the only place they could learn about our metallizing systems.

"It's been my experience that our trade advertising is getting to the right people. In many cases this man is an executive who is hard to see on a cold call. But he's a guy that will take the time and trouble to read and he's just the one to drum up interest in metallizing down the line in his company. In other words, you get more action if the suggestion comes down to the production department or the plant engineer from this executive."

Why not ask your own salesmen what your company's business publication advertising does for them. If their answers are generally favorable you can be sure that your business publication advertising is really helping them sell. If too many answers are negative it could well pay you to review your advertising objectives—and to make sure the publications that carry your advertising are read by the men who must be sold.

National Business Publications, Inc.

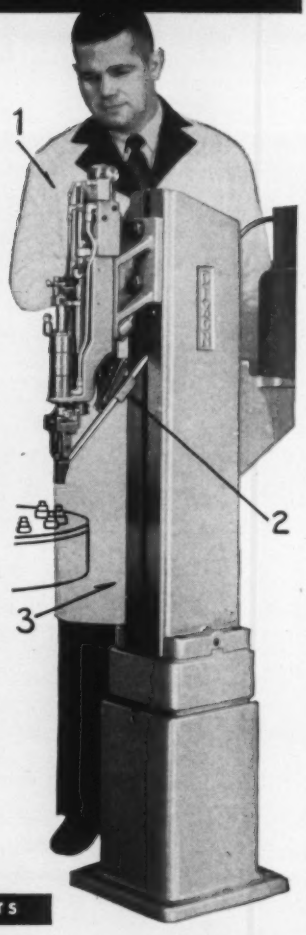
NBP

...each of which serves a specialized market in a specific industry, trade or profession.

1413 K Street, N.W., Washington 5, D.C. • STerling 3-7535

Announcing New Standard DIXON "Auto-Positioner"

SIMPLIFIES SMALL PARTS ASSEMBLY OPERATIONS



AUTOMATICALLY GUIDES PARTS OF 1/16" TO 3" O.D. SIZE AT RATES UP TO 6000 PER HOUR

The new Dixon "Auto-Positioner" combines three standardized units — (1) Escapement, (2) Automatic Positioner, and (3) Mounting Structure — and now provides an economical solution for automating small parts assembly operations. "Auto-Positioners" are easily arranged at single or multiple stations with fixtures, feeders, feed tracks, transfer or indexing tables. The positioner, properly tooled with a proven feeder, can place parts at rates up to 6000 pieces per hour. Full electrical controls are included with provisions for automatic interlocking.

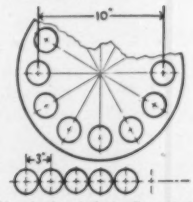
FEATURES OF STANDARDIZED UNITS

1-DIXON PARTS POSITIONER—a compact, self-contained air-operated automatic cycling unit with exclusive built-in sensing features. Automatically stops your machines when parts are missing or malformed. Handles parts of 1/16" up to 3" O.D. size. Engineered for mounting individual chuck jaws to suit varied requirements. Four standard models available with 1", 2", 3", 4" strokes.

2-DIXON PARTS ESCAPEMENT—Automatically releases single parts or in multiples at speeds up to 200 piece-parts per minute. Blank rear finger is easily shaped to suit piece-part. Standard models available for air, solenoid, or mechanical operation.

3-DIXON MACHINE STRUCTURE—Includes rugged semi-steel column with machined T-slots, sturdy base, and spacer blocks to suit varied locating and operating requirements. Compactly designed to fit in small space. Special support brackets available for feeders, work tables, etc.

INDIVIDUAL UNITS OR ANY COMBINATION OF STANDARD COMPONENTS AVAILABLE FROM STOCK. TOOLED "AUTO-POSITIONERS" PROVIDED TO SUIT NEEDS.



May be located at adjacent stations, only 3" apart for straight-line indexing, or on 12-station dial with a 5" fixture radius.

WRITE FOR FREE DATA SHEETS
New bulletins supply specifications and application data on standardized units now available from stock.

DIXON

DIXON AUTOMATIC TOOL, INC.
2312 - 23RD AVENUE ● ROCKFORD, ILLINOIS

AUTOMATIC PARTS HANDLING AND ASSEMBLY EQUIPMENT

AUTOMATION

• problem forum

Readers with problems concerning systems, equipment or components for automated operations are invited to outline them to: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio. Solution suggestions should refer to case number and title of the problem involved.

Case 1274-P
Positioning Device

. . . We are in need of a positioning or displacing device having a pull of about 2 to 4 lb. It is to be electrically operated and the magnitude of displacement is to be proportional to the current passing through it. The device could be a motor or solenoid which can be connected in series in a dc load bus. The current drawn by a load would pass through the positioner which would then be displaced linearly or rotationally in proportion to the current flow. Please advise whether you can locate any suppliers. . .

Chief Development Engineer

• • •

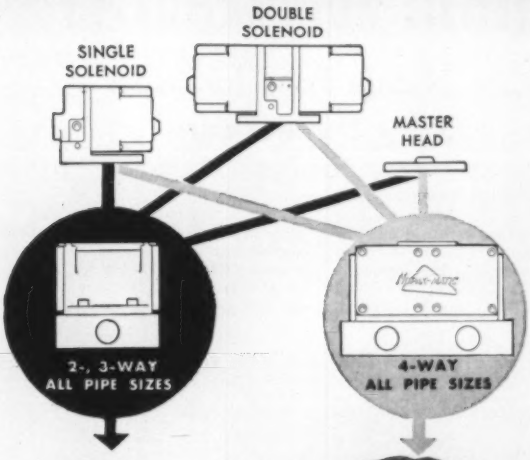
Case 1261-P
Charging Thermostatic Units

. . . We are manufacturers of various types of heating, refrigeration and air conditioning controls, and several of these products have one thing in common, the charged bulb, bellows or diaphragm for thermostatic operation. The charging of these assemblies has always been a costly operation, since the evacuation, purging, and charging of either gas or liquid fill units has been a manually controlled operation, with some of the evacuation cycles being as long as 3 minutes.

For some time we have been discussing the possibility of a programed operation on a manifold type of rack with operator requirement cut down to just load and unload for a production of approximately 1500 units per day. Do you know of anyone who is doing a similar operation semi-automatically and whether they would be interested in discussing it with us. . .

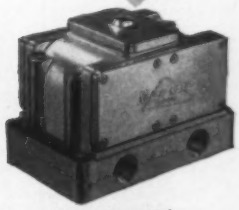
Industrial Engineering Mgr.

ONLY 3 PILOT HEADS fit all models

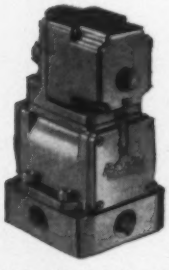


Another *Plus Value* in NOPAK-MATIC poppet-type air control valves

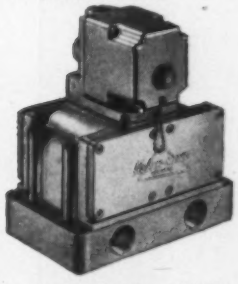
2-, 3-Way Master Valve



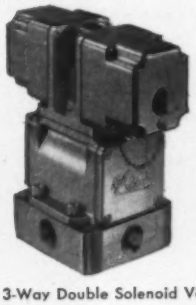
4-Way Master Valve



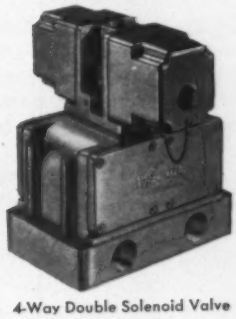
2-, 3-Way Single Solenoid Valve



4-Way Single Solenoid Valve



2-, 3-Way Double Solenoid Valve



4-Way Double Solenoid Valve

NOPAK-MATIC Plus Value Valves are available in ¼", ⅜", ½" and ¾" pipe sizes, for 2- or 3-Way Normally Open or Normally Closed or 4-Way operation with master (air), single or double solenoid pilot control heads.

Meet more air control needs with fewer valves

Nopak-matic valves, with exclusive automatic "Flow-Director" pilot heads, reduce valve and parts inventory. Fewer valves meet more application requirements.

Any pilot head (master, single or double solenoid), fits every valve regardless of type or size. Valves can be quickly converted from master to single or double solenoid control in a matter of minutes.

Other Plus Values in Nopak-matic

- **100% J.I.C. conformance at no extra cost.**
- **Exclusive "Flow-Director" pilot heads for more versatile application.**
- **Replaceable, self-cleaning seats.**
- **New, fast-maintenance design.**
- **Lightweight, corrosion-resistant construction.**
- **Split second response — Full flow.**

Get the Full Story!

SEND FOR CATALOG 105. It describes in detail all the NOPAK-MATIC Plus Values, and contains complete installation, dimension and parts data.

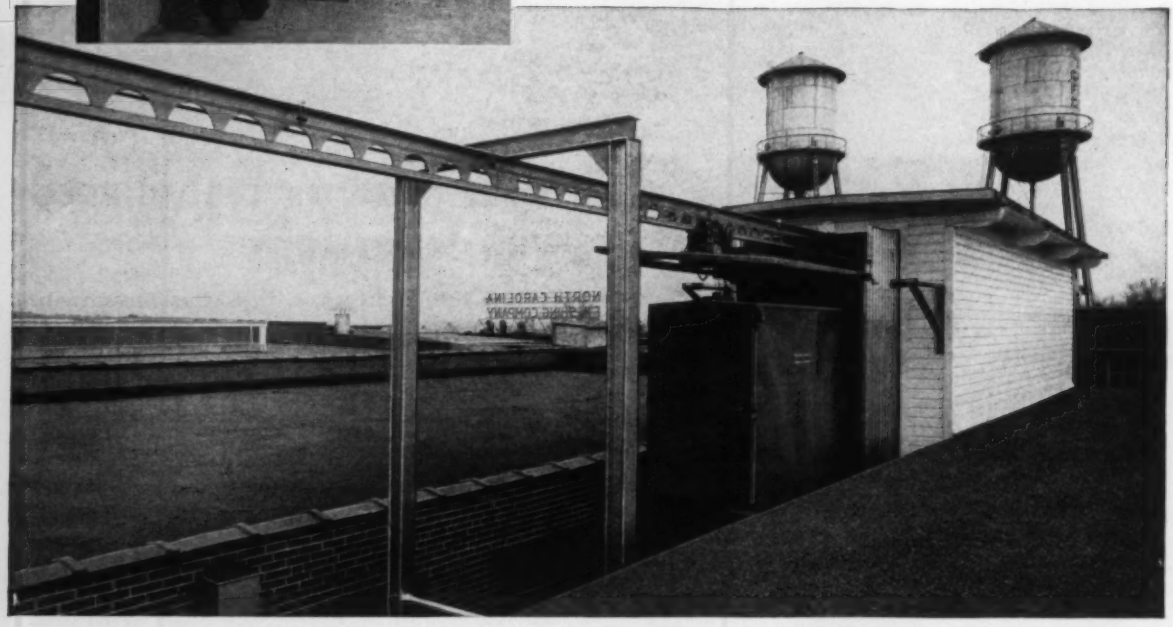
Specify **NOPAK** **VALVES and CYLINDERS**

GALLAND-HENNING NOPAK DIVISION • 2734 South 31st St. • Milwaukee 46, Wis.

Uses Skyway For Handling Materials AUTOMATICALLY

Completely Pays for Itself Every Three Years

Loading a van on the second floor of a building. This same van also may be lowered to the floor below for loading. Although the building at this end of the system is quite old, the Cleveland Tramrail equipment was easily installed. For years this vast roof area did nothing more than provide protection from the weather. Now it is being used profitably for materials handling. Illustrated is the van emerging from the penthouse.



BY erecting a Cleveland Tramrail materials handling system over the roofs of its buildings, a large plant is able to transport materials between departments located in widely separated buildings at very low cost.

Because the system operates automatically, the Tramrail carrier travels back and forth without any operator. The carrier van is loaded or unloaded at convenient areas inside the buildings. Pressing a button sends it on its way. It rises vertically to a penthouse on the roof. Then it makes its run over the track system to the penthouse at the other end. Here it lowers to the floor inside for loading or unloading.

The system eliminates considerable floor traffic and saves space required for wide aisleways. It operates at any time, day or night. Inclement weather does not hinder it. The system requires only a fraction of the maintenance necessary for floor handling equipment. It does not wear or damage floors. It is a big aid to safety. In addition to these important benefits, the Cleveland Tramrail system makes tremendous time savings — enough to completely pay for the entire installation every three years.

Cleveland Tramrail has had wide experience in automatic dispatch materials handling systems of many types. Our engineers will welcome an opportunity to work with you.

CLEVELAND TRAMRAIL

Overhead Materials Handling Equipment

CLEVELAND TRAMRAIL DIVISION • THE CLEVELAND CRANE & ENGINEERING CO. • 1319 E. 290th St. • WICKLIFFE, OHIO

PULSE SERVOS SAVE POWER

By HAROLD ADKINS
Project Engineer
Detroit Arsenal, Mich.

THERE IS a growing need for dc type servos. The lack of ac power, the requirements for low standby power, very high efficiency servomechanisms, have directed the development along the relay power-amplifier type. This paper will cover the power-type servos ranging from a millihorsepower peak to several horsepower. The efficiency on typical units is about 40 per cent, which is much higher than most alternating current servos. The very high starting torques of series-wound dc motors enables them to handle large inertial loads.

Pulsing servomechanisms may be divided into three general categories: (1) pulse occurrence dependent upon error; (2) continuous pulse with zero to full-time duration pulses dependent on error; and (3) full-pulse continuous bidirectional pulse where only the relative duration of full power opposite direction pulses is varied.

The first system usually includes a conventional amplifier which closes a relay driving the motor. A refinement generally included is a desensitization or throttling of the amplifier whenever the output relay is closed. This resembles a rate feedback since it is assumed that whenever the motor is powered it has a certain speed. A compromise desensitization setting is usually used since with small corrections the motor does not attain full speed, and many pulses are needed to establish a null. This throttling action leads to the often used name of pecking or pulsing relay system. The second system of obtaining a wide speed range on a high-torque series-type dc motor is that of varying the pulse width and/or frequency. The third type is a full bidirectional pulse with duration unbalance to give output torque. Normally the pulse-left, pulse-right durations are equal and the net result is zero average motion. If it is desired to move left, then the right pulses are made shorter, the left longer, giving a net force and motion left. This system has been applied to both hydraulic and electric systems.

Any comparison in efficiency of ac proportional versus dc pulsing relay servos must be made on a system and long-time basis. The amplifier efficiency will vary with load. Holding against a steady load, correction frequency and correction amplitude all enter in the final figure of efficiency, since many dc systems require no holding power. The inverter efficiency usually must be considered in a total system. For many applications and systems, a factor of 10 or more in power consumption often dictates the use of pulsing dc systems over ac proportional systems. Settling time, null error, and stability have been adequate for many applications. The choice of amplifiers and ac or dc bridge supplies is at least as flexible with pulsing systems as with proportional systems. The dc types usually will hold against large loads with no current consumption, whereas the ac types require hold-in power.

Applications

In typical installations of the first type the servo actuator motor usually represents at least one half the system inertia. On the small computer servos the load is mostly friction which helps damp the system. Relay hysteresis and motor coast tend to make the system unstable and are compensated by the throttling action. The motor clutch-brake combination is usually best since the armature does not need to be stopped by the amplifier. There is a limit to the maximum size of pulsing units since as the armature inertia goes up the brake generates more heat than can be dissi-

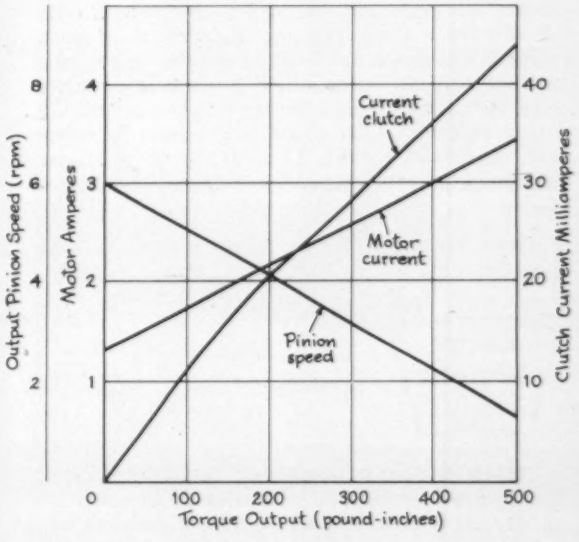


Fig. 1—Typical performance characteristics for a magnetic-particle clutch servo actuator.

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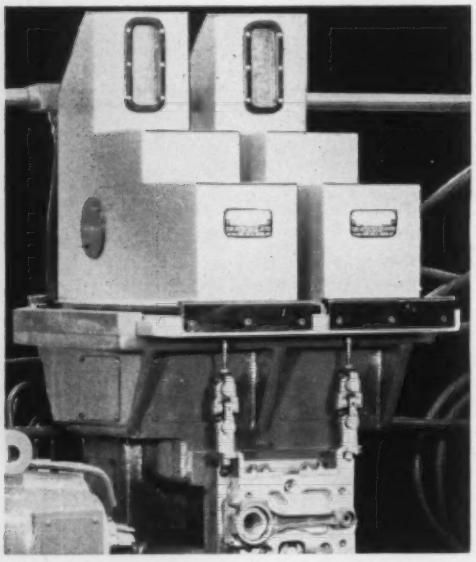

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pated. Permanent magnet field motors can be stopped by shorting the armature leads but the relay contact scheme is much more complicated than for a split-field series type. Size of permanent magnet field motors is not limited as evidenced by the recent development of a 2 hp average and 12 hp peak, 13 ft-lb stall and 0.001 slug-ft^2 motor whose dimensions are 4¾ inches in diameter by 9½ inches long. Recent developments of special field materials should make possible even better motors of the permanent magnet field type.

One of the simplest systems is a pulse dependent on error, two-stage relay amplifier. The sensitive relay system can have throttling action by providing additional coils for that purpose. Amplifiers using sensitive D'Arsonval movement type relays have been built and found to be rugged but inadequate in response time. The most satisfactory of all relay amplifiers used to date employs a 100-microwatt, 100-cps maximum frequency, *SPDT* ultrasensitive polarized relay followed by a power relay. Another example of a type 1 system is that used in ballistics computers for tanks. Most such computers have used 28-volt dc motors for driving the sights. A typical drive uses a motor with the following characteristics: 2.6 amp current draw at 26 volts dc, 0.1 duty cycle, and 10 in.-lb of torque. This actuator has been run from transistor, electronic, straight relay, and magnetic amplifiers. Its output is sufficient for many uses and the complete package size is very reasonable. The output is approximately 26 watts. The efficiency is about 39 per cent for the motor alone and 29 per cent for the total system if corrections are inserted continuously. The system will track and repeat to better than 0.1 per cent in about 3 sec from center to any extreme. Operating power is 120 watts, with the average power in normal use about 5 watts. An ac system was constructed for comparison which had only 10 watts output and did not have the series motor breakaway-torque capability. The steady power drain of the ac motor was 35 watts with an additional 35 watts in standby and 90 watts when in operation. The average ratio of power for dc versus ac was about 1:11.

A system having excellent speed of response, gain, and general characteristics uses magnetic-particle clutches, *Fig.* 1, controlled by relays. The clutches are capable of approximately 440,000 rad/sec^2 acceleration and deceleration and the power gain is high. Since only about 1 watt clutch coil power is necessary for full output, a very small, fast relay can be used. A relay which pulses at over 400 times per sec is available and this gives control equal to a 400-cycle ac servo but with a much higher efficiency. An example of favorable size, weight, and power considerations is a 3½ lb unit with radio noise filter which supplies 20 mechanical watts at an average efficiency of about 12 per cent. The motor input is 28 volts dc at 3 amp. The output is 2.2 rpm at 400 in.-lb torque. From these characteristics it can be seen that with a rate generator on the output the conventional performance gain available through rate and acceleration feedback can be applied successfully. The disadvantage of

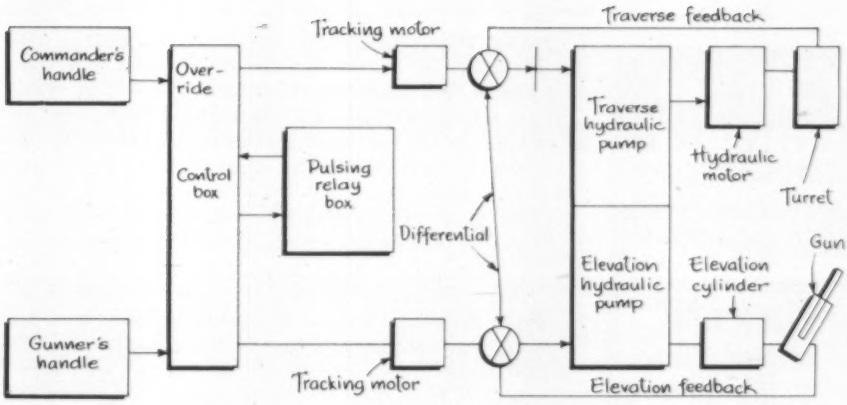

Fig. 2—Block diagram for a full-voltage pulse type servo for gun and turret control in ordnance vehicle. Tracking is effected by variation of pulse length.

this system is the low average efficiency when a large constant load has to be held in position. This disadvantage could be overcome by the addition of another pair of clutches, two more relay contacts and a mechanical system resembling the *C*1 autopilot servo. There are many minor modifications of the brake-clutch-type servo in use, such as the loudspeaker type dual clutch; however they have all been found inferior to date in acceleration and power sensitivity to the magnetic-particle type and thus are not covered.

The system shown in the block diagram, *Fig.* 2, is used to control a gun in elevation and a gun and turret in traverse. Accurate control is required from 0.3 to 640 milliradians per sec. A hydraulic system, controlled by the pulsing relay system, drives a differential in the position feedback loop. The pulsing relay servo is a rate-type system. The average input to the servo is 5 hp with a capability of 15 hp peak. The tracking motor driven by the pulsing relays has a speed range of 6 to 12,000 rpm. Since this speed range cannot be covered by simple

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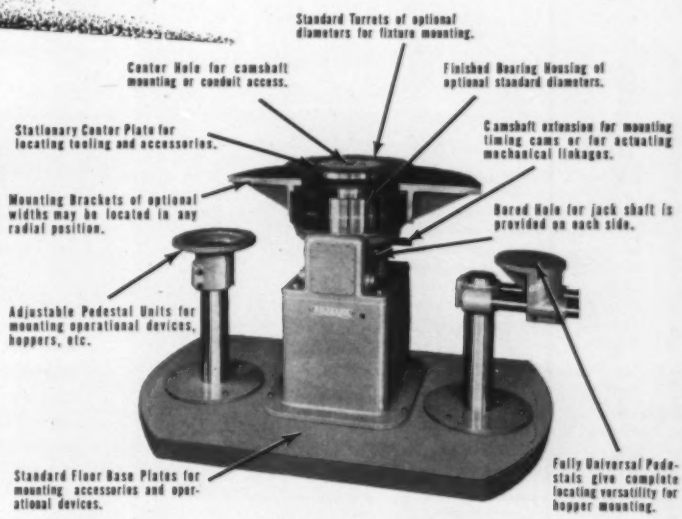
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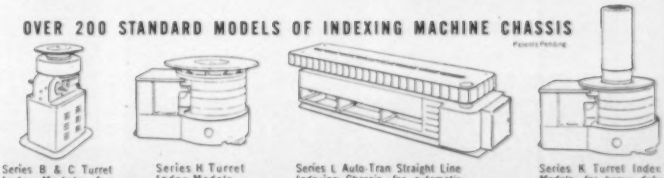

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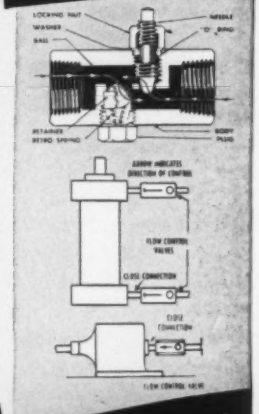

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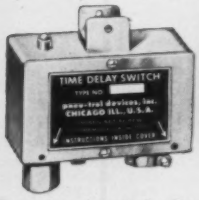

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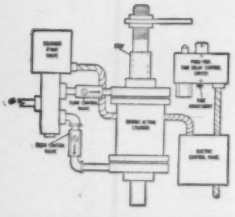

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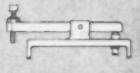
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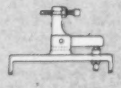
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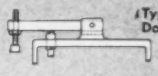
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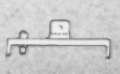
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field and armature voltage variation, full-voltage pulses with pulse-length variation are used. Displacement of the control handles causes the relay to pulse and start the tracking motor. The tracking motor, through the differential, places the hydraulic pump in stroke, furnishing power to the hydraulic motor on the gear box. The turret drive pinion gears move the turret and a set of gears picks up the turret movement and feeds back a signal indicating movement to the other side of the differential which the tracking motor is serving.

In summary, it is believed that in applications where system efficiency is important both from the power and weight standpoints, the pulsing dc servomechanism using split-series wound or permanent-magnet motors has a very important role. It can be either simple or complex and can cover a very large horsepower range. Some performance must be sacrificed over proportional systems.

From a paper entitled "Practical Aspects of Relay or Pulse Servomechanisms" presented at the Instruments and Regulators Conference of the American Society of Mechanical Engineers, Evanston, Ill., April 1957.

ELECTRONIC DATA PROCESSING FOR MANAGEMENT

By RICHARD F. NEUSCHEL
Management Consultant
McKinsey & Co. Inc.

THERE ARE just three possible justifications for using electronic data processing machines in the management field (that is, exclusive of their possible application in the design or engineering fields). These are: (1) To cut clerical costs; (2) to produce faster and better management control information than is practicable by alternative methods; and (3) to facilitate the application of mathematical analysis techniques to the solution of business problems.

Clerical cost reduction deserves first consideration because it is the potential benefit that has induced most companies to inaugurate their EDPM programs.

By and large the use of general-purpose computers on routines such as these has not yet produced the savings that were hoped for. This does not mean, of course, that worth-while economies will not ultimately be achieved as experience is gained in the use of computers and as improved, lower cost equipment is introduced. But, the problem of ensuring that EDPM will produce *real* savings in clerical costs is still not quite that simple. Regardless of what improvements may be made in electronic hardware, management will still have to guard against four fundamental types of mistakes—mistakes that have lured more than a few companies into uneconomic electronic installations or have concealed the fact that the savings which have been achieved resulted from factors other than the electronics installation itself.

The first of these four mistakes lies in making the assumption that if something can be done elec-

tronically, that must *per se* be the best way of doing it.

In our experience, the *method*—that is, the manual or mechanical means—by which paperwork is performed is generally the least important of the several ways to cut clerical costs. Ordinarily, much greater cost reductions can be realized by: (1) Making a critical, hard-headed re-evaluation of the work that needs to be done; (2) analyzing the indirect factors—such as policies and organization structure—that affect the complexity or volume of clerical work; and (3) using objective measurement techniques for determining how many people are really needed to do the required work. Until these basic steps are taken, no amount of office automation will produce real efficiency.

The second type of mistake that has been made in a good many electronic feasibility studies is that of underestimating the one-time changeover costs—that is, the costs of preparing for, installing, and perfecting the use of the computer. These estimating errors have been of two types: Not providing enough time or money for preparatory steps that are recognized, and overlooking some elements of cost entirely. The reason why this sometimes happens is suggested by TABLE 1 which shows the great diversity of work involved in preparing for computer operation.

In addition to underestimating the extent of the preparatory work, a third type of mistake that has been made is that of underestimating the recurring operating costs of the EDPM setup. Any proposed system that exists only on paper is always highly idealized. It seldom reflects the exceptions, the tributaries of the main stream of paperwork, or the clerical mistakes and inefficiencies that are built into the cost of the present procedure with which it is compared To avoid this error trap, the administrative vice president of one company insists that the estimated costs of proposed systems or methods be increased arbitrarily by 20 to 25 per cent before they are compared with present actual costs.

In a fair number of feasibility studies, machine operating time has been badly underestimated. On some applications, for example, actual processing time has proved to be two to three times as great as originally estimated. One reason is failure to program skillfully or to anticipate the number of programing steps involved. Another is the necessity for running all transactions through a complicated series of machine steps to test for rare exceptions.

A final common error affecting the EDPM operating cost is that of overestimating the degree of machine utilization. Two important underlying reasons here are: Failure to anticipate the amount of maintenance down-time involved, and failure to recognize that peaks and valleys in work load are just as much a problem in electronic applications as they are in punched-card procedures.

The fourth fundamental type of mistake that has been made in estimating the payout of computer applications is to attribute to the EDPM installation clerical savings that could have been achieved without converting to electronics. The detailed systems studies that underlie most computer installations

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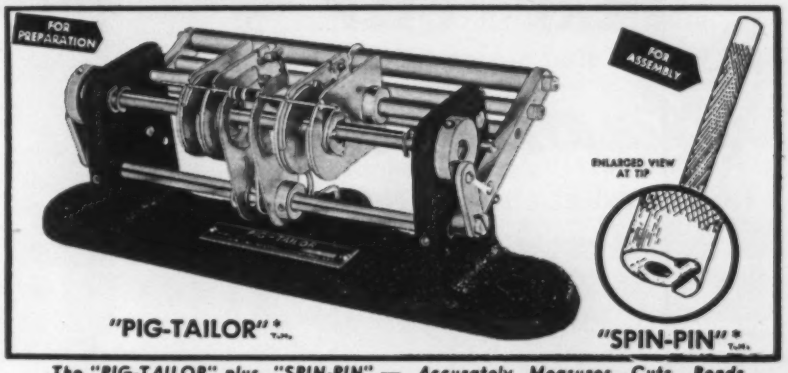

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have forced a great deal of simplification, elimination, and standardization of existing clerical operations. In addition, they have brought about such other improvements as a reduction in the volume of exceptions and special handling, the development of uniform codes that facilitate data handling, and the centralization of clerical work to obtain the economies of large volume.

Improvements of this character can be immensely profitable. But, it is equally clear that they can be made within the framework of your present basic methods. To insist on an electronic computer installation as a means of achieving them is a great deal like "burning down a barn to get roast pig."

In light of these four types of potential mistakes, here are some guidelines for top management to apply in testing the applicability of an electronic computer to the routine, day-to-day transactions of the business:

1. Insist that savings estimates be *proved* and *demonstrably conservative*. That is, make sure that they are supported in detail and are not merely broad, over-all estimates.

2. Be sure that provision has been made for every one of the elements of preparatory cost shown in TABLE 1.

3. Require the task force to estimate how much the cost of existing systems and procedures could be cut by applying to them only part of the analytical effort that will go into the electronic installation.

4. Do not be content merely with determining that the proposed installation will, in fact, save some money. Rather, express the estimated saving as a rate of return on the investment involved—that is, the annual saving in operating costs as a per cent of the one-time cost of making the study and changing over to the new system. Then ask: How does this return compare with the company's demanded rate of return on proposed investments in new production facilities?

5. Remember that in most cases in which computers are being considered, skilled manpower is

TABLE 1
Nonrecurring Costs in Preparing for EDPM Operations

1. Making the feasibility study and obtaining a decision.
2. Flow charting present procedures in detail, standardizing or modifying as necessary to fit them to electronic processing.
3. Training programers.
4. Programing the computer for each proposed application.
5. Preparing physical facilities for the installation (partitions, foundation, sound-proofing, air-conditioning, etc.).
6. Training operators and technicians.
7. Indoctrinating executives, supervisors, and workers who will be affected by the computer installation.
8. Converting data to the new system (e.g., recording material, changing over records).
9. Setting up and test-checking the programs on the computer.
10. Operating the present systems in parallel with the new during the trial period.
11. Allowing for the effect of the learning curve. (This covers normal loss of efficiency during the first several months of operation. Since this inefficiency delays attainment of anticipated savings, it should be treated as an additional cost.)

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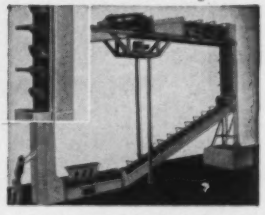

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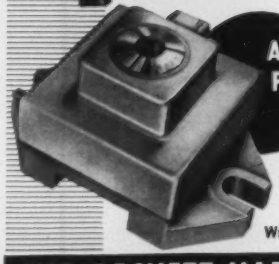

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more limited than is capital. Hence, before committing yourself to installation of a computer primarily to handle routine clerical activities, consider what alternative uses might be made of the personnel who are skilled in the analysis of management problems and in the design of other profit-making systems.

Management Control Information

As the bloom has tended to fade from the "cost-reduction rose," more and more attention has shifted to the so-called dynamic, profit-making applications of EDPM. One of the most widely heralded of these is use of the computer to produce faster and better information for the control of operations.

There is no question but that electronic equipment can provide more information faster than can any other kind of equipment. But, because this is true, a number of thoughtful businessmen are beginning to wonder if our ability to assimilate and use management information intelligently has kept pace with our ability to generate it. To the people who tell us how to get more facts faster, one is impelled to raise such questions as these: Are we becoming so diverted by the lure of office mechanization that we have lost sight of a far greater need to sharpen our skills in determining *what information is of real worth?* With the promise of an enormous increase in the volume of information, is management moving toward the day when it will need to be rescued from its accountants and its statisticians? What specific steps can be taken to avoid the mechanical hypnotism that will cause high-speed figure-producing devises to do more harm than good? As masses of operational data become more readily available, what is to keep higher levels of management from becoming so immersed in day-to-day operations that they seriously undermine any form of delegation or decentralization? What is to keep this short-term operating focus from diverting top management even further from its critical long-range planning responsibility?

In any fundamental approach to identifying management's real information needs, it has been our experience that the first step should be to isolate the critical factors on which success of the business depends. For any business—large or small—these will ordinarily consist of not more than four to six factors. They are the activities or aspects of the business that have a major impact, not only on short-term profit results, but also on long-term growth and competitive strength.

Obviously, these factors will vary widely from industry to industry. For example, in the automotive industry they include car styling, maintenance of a hard-hitting dealer organization, and achievement of competitive manufacturing costs. In the chemical business, the list of factors would include development of new products or new uses. For a distributor of major appliances, effective inventory management would be critical. For a life insurance company, marketing effectiveness, investment management, and home office cost control would be among the keys to success.

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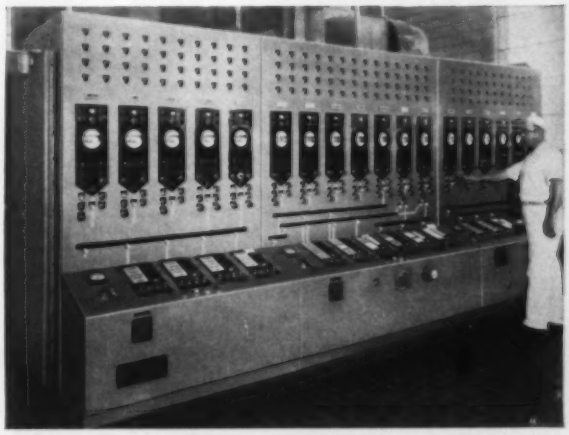

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THE STANDARD OF ACCURACY SINCE 1888

step in defining management's real information needs is to break down each factor into its *profit-making components*. These are the important elements of performance that have to be controlled individually to ensure satisfactory over-all results. For example, one consumer goods manufacturer listed marketing effectiveness as a factor critical to success. In breaking down this factor, company executives listed the following four elements of performance: Market penetration (number of outlets), share of market, profitability of the mix sold, and strengthening of the distributor organization.

Completion of these two steps will provide an inventory of management information needs substantially different from those that are met by traditional accounting and statistical concepts. To illustrate what can be accomplished from applying this approach, one company that used it was able to reduce its recurring reports from 560 to 140 and the number of copies of reports being distributed from over 2800 to 460. An interesting sidelight is that the number of reports received by the president was reduced from 83 to 18.

But reduction in the quantity of information still was not the most important result achieved. The big gains—in terms of their bearing on management effectiveness—were scored in the *quality* of the information produced. These were achieved by ensuring that each executive was receiving the facts he needed to keep his attention riveted on the important factors controlling end results.

Operations-Research

The third and final potential use of EDPM is in the so-called operations research area—that is, as a means of facilitating the application of advanced mathematical techniques to the solution of business problems.

Much has been written about operations research and a great deal of work is being carried on to refine, test, and extend the techniques involved. Yet relatively few companies, thus far, appear to have used their electronic installations for this purpose. As an illustration, in the survey made by my firm, of the 23 companies that have computers in use or on order, only three are actually attempting to develop some operations-research applications.

But to bring these promising developments into perspective, here are four guidelines to consider in determining whether or not your company has sufficient operations-research work to warrant acquisition of your own electronic computer:

1. *Not all companies have the same type of opportunities to use operations-research techniques profitably.* Typically, companies in which these techniques are most applicable are those that represent a complex situation of interdependent factors—that is, companies that have a good many repetitive operating problems involving a large number of related variables that can be expressed quantitatively. For example, the number of opportunities to apply O-R techniques requiring computers in their solution are probably greater in oil refineries and consumer paper-goods manufacturers (with their high facilities

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investments and distribution costs) than in, say, a specialty pharmaceutical manufacturing company in which by far the most important factor affecting competitive position is skill in new product development.

2. *Not all operations-research problems require EDPM for their solution.* It is true, of course, that electronic computers are capable of performing the calculation work required in virtually all O-R problems. But, as one leading O-R specialist has said, "The use of an expensive computer on many O-R problems is like shooting gnats with cannonballs." In fact, this authority has estimated that only a relatively small percentage of all O-R problems require the computing capacity of electronic equipment. The great remaining volume can be handled by simpler computing devices such as pencil-and-paper calculations, slide rules, and hand-operated desk computers.

This in no way denies the fact that large-scale computers have greatly enlarged the field of operations research for they do permit the solution of mathematical problems that just could not be tackled before because of the volume of computing work required. Important types of problems falling into this category are those that have been identified by the terms *linear programing* and *dynamic programing.*

3. *Companies that do have O-R applications requiring computers do not necessarily need to buy or rent their own computers to fill this need.* Many operations-research problems requiring electronic computers are simply "one-shot" problems. That is, after having been solved once, such problems can often be reduced to a formula which, in turn, can be administered by clerical personnel. The volume of operations-research work for most companies is likely to be so small that they would be much better off to farm out such problems to the computer-service organizations that have sprung up, both as commercial enterprises and as extensions of university activities.

4. *Do not make the mistake of assuming that the mere acquisition of EDPM will result in performance of any significant amount of operations research within your company.* The existence or use of a computing device still leaves a company a long way away from the application of operations research type of thinking and analysis to its problems. If you are not doing O-R work without your own computer, the chances are you will not do any more simply by acquiring a computer.

There is no question but that EDPM is destined to play an important facilitating role in the fulfillment of the three fundamental needs. But, the mere acquisition of a computer will not, by itself, bring you one bit closer to filling them. The companies that profit most will be those that have the discipline and the perception and the resourcefulness to meet these three needs head-on, instead of approaching them through the back door of electronics.

From a talk entitled, "What Top Management Needs to Know About Electronic Data Processing" presented at the West Coast General Management Conference of the American Management Association in Los Angeles, Jan. 1957.

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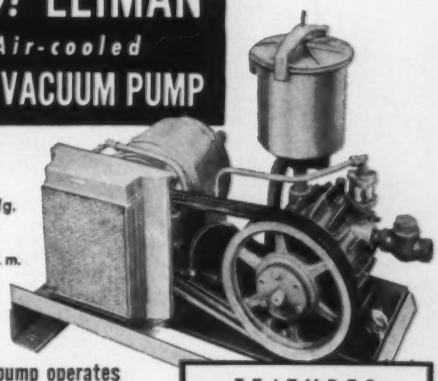

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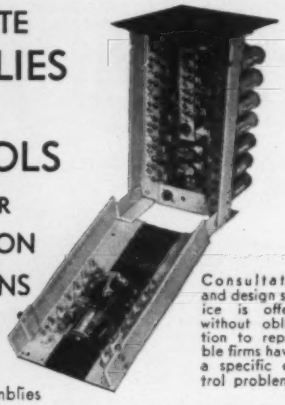

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AUTOMATION patents

Copies of patents are available at 25 cents each from the Commissioner of Patents, Washington 25, D.C.

LINE DIVIDER

Vacuum cups rotating on a carrier take articles from a loading station and selectively release them at one or more receiving stations. Patent 2,789,680 by Charles E. Kerr, assigned to Food Machinery & Chemical Corp.

STOPPING MECHANISM FOR CAN BODY MAKING MACHINE

Reciprocating feed mechanism operating through a feeding stroke and a return stroke can be stopped for abnormal conditions only on the return stroke of the feed mechanism. Patent 2,791,978 by Ronald E. J. Nordquist and Nelson Geertsen, assigned to American Can Co.

AUTOMATIC JIG-LOADING APPARATUS

Articles are fed from a hopper to aligned positions in a magazine and then automatically deposited on a jig as it is passed under the magazine. Patent 2,791,075 by Domenic L. Cafarella and Charles R. Cafarella, assigned to Crown Wire Mfg. Corp.

AIR BLAST STRIP FEEDING MEANS

Light thin paper stock is fed at high speed through a narrow passage by directing air obliquely against both sides of the paper within the passage. Patent 2,790,638 by William Wockenfuss, assigned to Burroughs Corp.

VENDING MACHINE CONTROLLED BY CREDIT IDENTIFICATION MEANS

Fluid dispensing machine is actuated by a magnetic credit card and automatically measures out fluid, calculates price, and prints cost on an invoice. Patent 2,792,148 by Julius L. Goldenberg, assigned to Hotelevision Co.

TEST CELL FOR CONTINUOUSLY DETERMINING MOISTURE CONTENT IN COMMINUTED MATERIALS

Material is fed up through a vertical tubular casing by a feed screw and flows around an electrode suspended above the upper end of the screw. The electrode and the casing act as the electrodes for a capacitance system for determining moisture

content. Patent 2,788,487 by William Grogg Jr., assigned to Quaker Oats Co.

LOG FEEDING APPARATUS

Rotating the floor of a circular bin causes logs to be discharged by centrifugal action endwise through an opening in the stationary wall of the bin. Patent 2,792,099 by Joseph S. Hefft, assigned to Hewitt-Robins Inc.

CARD READING STATION

Apparatus continuously feeds punched cards between a light source and a photoelectric reading element. Cards are held by vacuum on the periphery of a rotating drum and momentarily lifted off the drum for reading. Patent 2,792,175 by Earl K. Amundsen, assigned to Hughes Aircraft Co.

CONTROL MEANS FOR A MULTIPLE OPERATION MACHINE TOOL

System controls a machine tool to perform a succession of machining operations in a predetermined order using only the proper tools from a plurality of receivers. An operation is carried out only upon the removal of the proper tool from its receiver. Patent 2,793,546 by Earl E. Opel, assigned to National Automatic Tool Co. Inc.

METHOD AND APPARATUS FOR INSPECTING CAPS

Apparatus to inspect caps for liners uses a wheel to index the caps past a light and photocell arrangement. A cap without a liner causes an electric impulse, due to the change in amount of light reflected, and is ejected. Patent 2,793,746 by Robert W. Meyer and Robert G. Swanson, assigned to Owens-Illinois Glass Co.

SENSING DEVICES FOR SELECTIVE DELIVERY CONVEYORS

Electrical contact arrangement senses arrival of an article at a discharge conveyor so that means can be actuated to deflect the article from a main conveyor. Patent 2,794,535 by William E. Hauschild and John E. Solecki, assigned to Western Electric Co. Inc.

METHOD AND APPARATUS FOR DETERMINING A COMPONENT IN A GASEOUS MIXTURE

Apparatus determines a component in a mixture of gases which radiate on compression or absorb on expansion. Sensitizing cells between the sample and two infra-red detectors make the device sensitive only to a key component. Patent 2,794,924 by Charles W. Skarstrom, assigned to Esso Research & Engineering Co.

ELECTRONIC INFORMATION-STORING DEVICES

Storage of information is provided on a charge-retaining surface in a cathode ray tube. Information is applied by a gating means which reduces the positive charge in strips along a track swept by a beam. Patent 2,794,937 by Frederic C. Williams and Tom Kilburn, assigned to National Research Development Corp., London, England.

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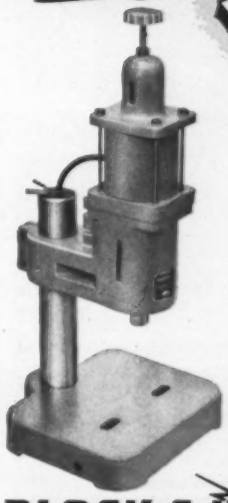

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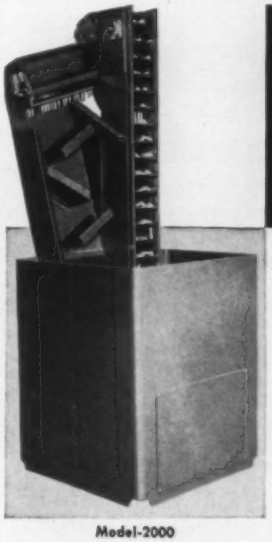

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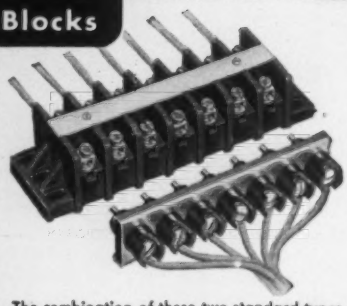

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SYSTEM ENGINEERING—AN INTRODUCTION TO THE DESIGN OF LARGE-SCALE SYSTEMS

By Harry H. Goode, professor of electrical and industrial engineering and Robert E. Machol, research engineer, University of Michigan; 551 pages, 6 by 9 inches, illustrated, clothbound, published by McGraw-Hill Book Co. Inc., New York; available from AUTOMATION; $10.00 *postpaid.*

Presupposing a mathematical background of elementary calculus, this book discusses the formulation and solution of system design problems by use of experimental data, statistical methods, game theory, linear programing and related techniques including mathematical models. The construction, operation and application of computers for solving system design problems are also explained. Numerous examples of design of systems in the communications, military and industrial fields serve to clarify the text. Bibliographies and sample problems are given after most of the 31 chapters.

ELECTRICAL TESTING AND TROUBLESHOOTING

By Philip T. Green, industrial training coordinator, Panama Canal Co., 191 pages, 6 by 9 inches, illustrated, clothbound, published by Industrial Press, New York; available from AUTOMATION; $4.00 *postpaid.*

The present day intricacy of electrical machinery and control equipment demands a logical step-by-step approach in testing and troubleshooting electrical faults. Such a procedure is outlined in this book, which is based on actual methods used by electricians in the field. Of particular value to non-electrical engineers is a chapter showing how to analyze typical control circuits element by element.

PUMP SELECTION AND APPLICATION

By Tyler G. Hicks, instructor in mechanical engineering, Cooper Union School of Engineering; 422 pages, 6 by 9 inches, illustrated, clothbound, published by McGraw-Hill Book Co. Inc., New York; available from AUTOMATION; $8.50 *postpaid.*

A broad survey of available pump types, their characteristics and applications, is presented in this book. Cutting across many industries and many fields, examples are taken of specific pumping problems and their solutions. Representative fields include: Conventional and nuclear power plants; petroleum, chemical, paper, food, and iron and steel processing plants; water, irrigation, flood control and sewage services; industrial hydraulic power and vacuum pumps. Chapters on pumping system economics, piping requirements and pump drives are included.

DIGITAL COMPUTER PROGRAMMING

By D. D. McCracken, manager-training, industrial computer department, General Electric Co.; 253 pages, 6 by 9 inches, illustrated, clothbound, published by John Wiley & Sons Inc., New York; available from AUTOMATION; *$7.75 postpaid.*

Written for the programmer, this book covers the mechanics of solving problems with digital computers. To assist in the discussion, the author has devised an imaginary computer which is programed with hypothetical problems of varying complexity. By this means, computing and coding fundamentals, number systems, addressing, flow charting and other operating techniques common to digital computers are introduced and explained. Exercise problems and a bibliography of related periodicals and books are provided.

ELECTRONICS IN INDUSTRY

By George M. Chute, professor of electrical engineering, University of Detroit; 431 pages, 6 by 9 inches, illustrated, clothbound, published by McGraw-Hill Book Co. Inc., New York; available from AUTOMATION; *$7.50 postpaid.*

This second edition provides a broad updated introduction to the use of industrial electronic circuits and equipment. It proceeds step-by-step, with only limited use of mathematics, to discuss vacuum tubes, rectifiers, filters, thyratron gas tubes, control functions such as speed and voltage regulation, timing and closed-loop servomechanisms. Actual circuits used for welding, heating, motion and register control are analyzed. The concluding chapter of the book covers transistors, amplidynes, and magnetic amplifiers.

Government Publications

Counters for Airborne Use. *Report* PB 111564 *by Aero Medical Lab., Wright Air Development Center, 13 pages, available from Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C.; 50 cents.*

Report presents an integrated survey and interpretation of psychological factors relevant to the design of counters. The advantages and disadvantages of counter displays as compared with other methods of presenting information are discussed. The effects on readability of speed and direction of counter, and location and mode of operation of associated control are analyzed.

Guide to Design of Electronic Equipment for Maintainability *Report* PB 121439 *by American Institute for Research for Wright Air Development Center; 180 pages; available from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.;* $4.50.

Guide contains examples of provisions which can be included during development of complex electronic equipment to reduce maintenance time and costs. Report also covers maintenance procedures and general factors governing maintainability of electronic systems.

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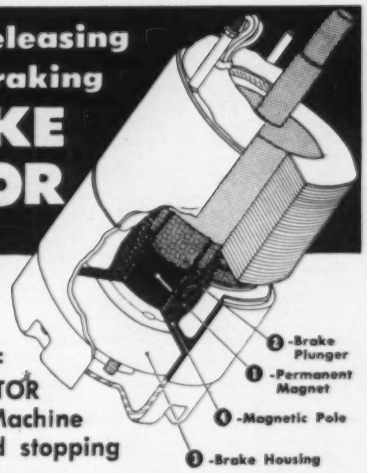

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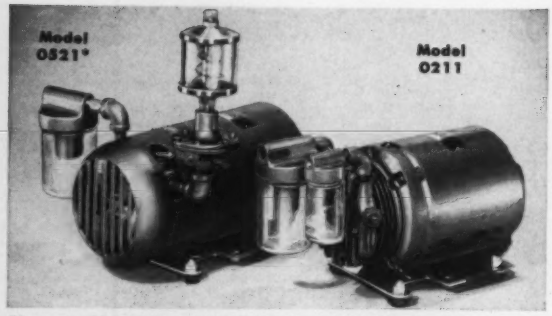

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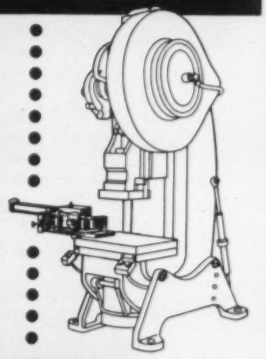

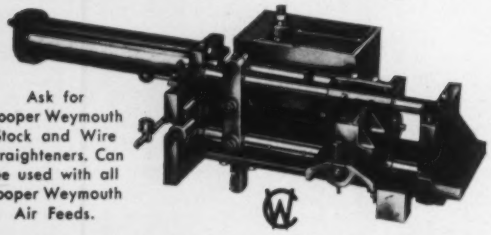

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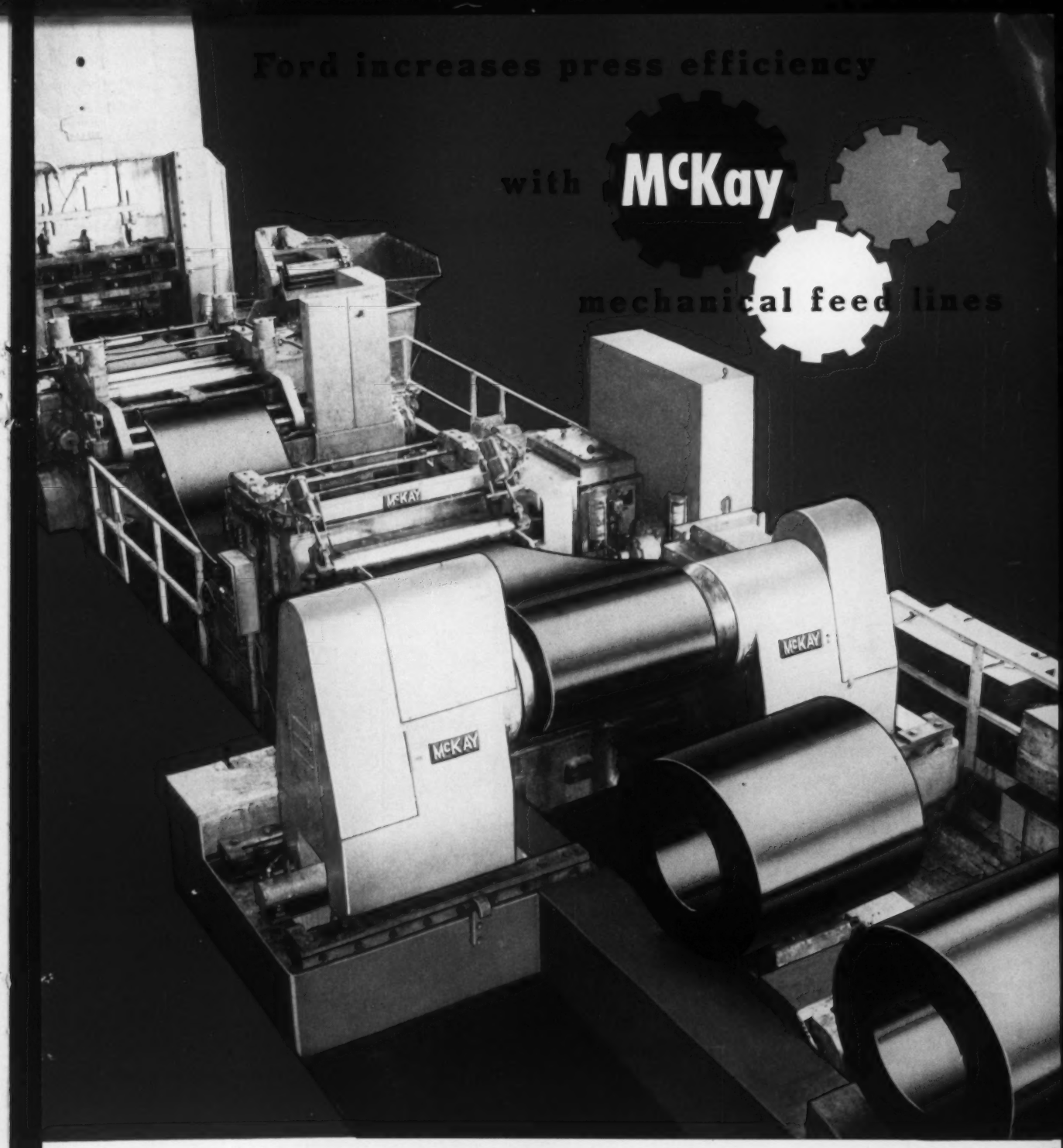

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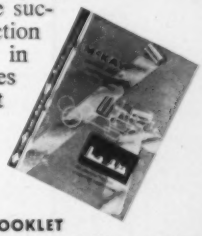

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